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TABLE OF CONTENTS

April 1948

	Page
The Evolution of Tactics and Weapons	5
Technique of Direct Fire, 57-mm and 75-mm Rifles (Restricted)*	58
Considerations Governing Operations in Snow and Extreme Cold	72
Organization and Principles of Employment of the Heavy Weapons Company in the Attack	98
Operations of a Rifle Company at Brest, France	114
Attack of a River Line	137

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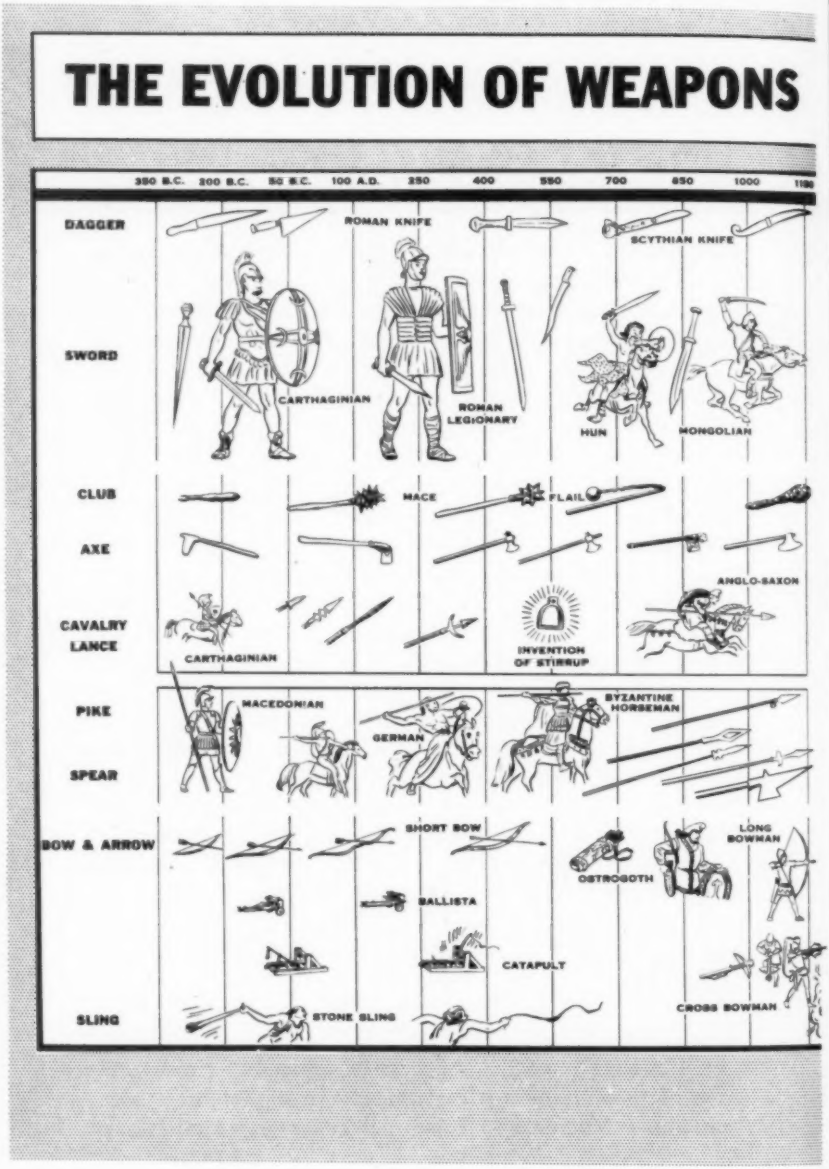
The Evolution of Tactics and Weapons

The plan for the attack was complete. The staff had been briefed; arrow-firing catapults and stone-throwers were in position to support the crossing of the Jaxartes River. The Greek Phalanx clanked forward with its heavy body armor and long spear-like sarissas. Alexander the Great, leading his favorite cavalry, moved his army to battle. This was the Fourth Century B.C.—the century in which the science of tactics surged ahead with the longest stride it had taken in 3,000 years.

Few of the weapons, formations, or tactics employed by Alexander in this and subsequent campaigns were of his own design. Alexander was an avid student of military history; he studied the campaigns of his predecessors—their weapons, formations, and tactics—and in applying this knowledge to his own situation, he conquered the world in twelve years.

The other great captains of history were also students of military history. Hannibal, Caesar, Gustavus Adolphus, Frederick, and Napoleon all prided themselves on their knowledge of the tactics of their predecessors. Modern military leaders still find enlightenment in the campaigns of Napoleon and the maneuvers of the Prussian generals. Leaders of the future will be guided by the tactical concepts which emerged from the Battle of the Bulge, the Breakthrough at St Lo, and the amphibious landings in the Philippines.

The evolution of tactics is a series of connected histories in which new weapons are developed, causing, or contributing to, a change in tactics. Figure 1 shows an artist's conception of the evolution of weapons. On the left are those in common use about 350 B.C., just before Alexander rose


THE EVOLUTION OF WEAPONS
350 B.C.
200 B.C.
50 B.C.
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250
400
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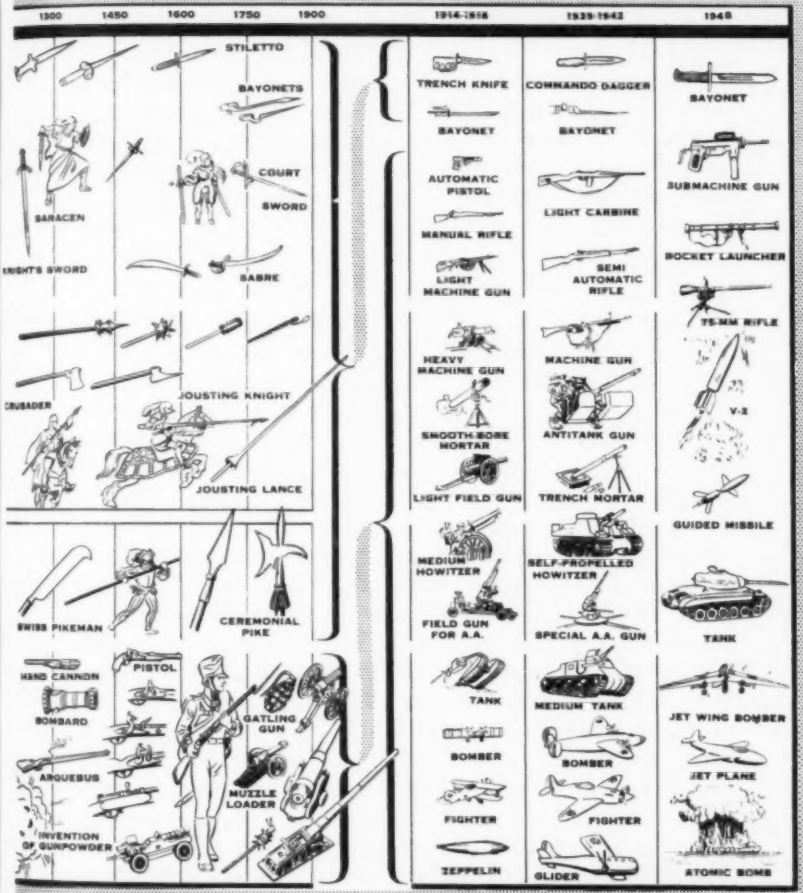
DAGGER
ROMAN KNIFE
SCYTHIAN KNIFE
SWORD
CARTHAGINIAN
ROMAN LEGIONARY
HUN
MONGOLIAN
CLUB
MACE
FLAIL
AXE
ANGLO-SAXON
CAVALRY LANCE
CARTHAGINIAN
INVENTION OF STIRRUP
PIKE
MACEDONIAN
BYZANTINE HORSEMAN
SPEAR
GERMAN
BOW & ARROW
SHORT BOW
LONG BOWMAN
OSTROGOTH
BALLISTA
CATAPULT
SLING
STONE SLING
CROSS BOWMAN

Figure 1.

FROM 350 B C TO PRESENT



to power. Note the more revolutionary of the subsequent inventions—the stirrup, gunpowder, the machine gun, the bayonet, the airplane, and the tank, and the atomic bomb. They are particularly important because the development of each of them activated a new phase in the evolution of tactics.

The discovery of metal suitable for the manufacture of weapons, about 2,000 B.C., is an outstanding example of the cause-and-effect relationship between the development of weapons and the evolution of tactics. Prior to this discovery, organized wars were not possible. Men simply met and fought with fists and clubs. Valor was the predominant characteristic of ancient warfare.

THE AGE OF VALOR

Tactics were accidental in the 30,000 years that preceded the discovery of metal suitable for weapons. Armies, which were almost exclusively infantry, met in hand-to-hand combat. Brawn, bravery, weight of numbers, massed attacks, and shock action decided the issue. There could be no organized wars because offensive and defensive weapons were not yet available.

Horses and chariots were used in warfare by the Scythians as early as 3,000 B.C. Fifteen centuries later Thutmose III of Egypt added armor to his chariots. Still later, small fighting teams were formed by grouping 25 to 75 infantrymen around a chariot—a forerunner of the modern tank-infantry team. The Persians were the first to mount their warriors on horses, but like their predecessors, they overlooked the possibility of using the horse itself as a weapon. In battle the Persian cavalry charged on horseback to close range, discharged a flight of arrows and spears, withdrew, and then repeated the maneuver. These tactics were annoying but ineffective and lent further proof to the fact that the development of cavalry had to wait for an invention that would permit a mounted man to shift his weight to his feet so he could strike a firm blow. This invention, the stirrup, was not conceived until 400 A.D.

China first used cavalry in 117 B.C. There, during the so-called Age of Valor, military conditions were strikingly similar to those in the Mediterranean area, with infantry dominating the battlefields. However, tactics of an advanced nature got an early start in the Orient, for about 550 B.C. the famous Chinese military historian, Sun Tze, wrote principles and precepts that are still sound in modern warfare. He advised: avoid long campaigns, aim at an early victory, avoid delay, strike quickly, strike where the enemy is weakest, strike where the enemy considers the ground impassable, and emphasize flexibility of plans. During the Age of Valor the Asiatic empires dominated the world's military scene. As the Age neared its close, cavalry and chariots were on the decline; infantry developed cohesion and discipline; hardened weapons and armor became more plentiful; and Greece, by improving the known weapons and by developing new tactical concepts, emerged as the first European contributor to the evolution of tactics.

THE GREEK PHALANX

The Greek phalanx, strictly an infantry formation, was an evolutionary development from the clumsy, heavily-armed masses of earlier times. Not only did it contribute further to the decline of cavalry, but it actually laid the foundation for the science of tactics and Alexander's conquest of the world.

The typical phalanx consisted of solid lines of foot soldiers, called hoplites, twelve ranks deep. Each soldier in this solid formation was armed with a 6-foot spear, a short sword, and a shield. To this phalanx (the central rectangle in figure 2) was usually attached a smaller force of more lightly-armed troops, who skirmished to its front and protected its flanks. The tactical employment of this formation was relatively simple; the phalanx marched straight forward to engage its enemy. This meant that, as before, the battle was a test of endurance and courage rather than skill. The formation lacked mobility and flexibility but it provided a disciplined fighting unit. Greek soldiers formed

in a phalanx invariably defeated the loosely organized Persians.

EARLY GREEK PHALANX

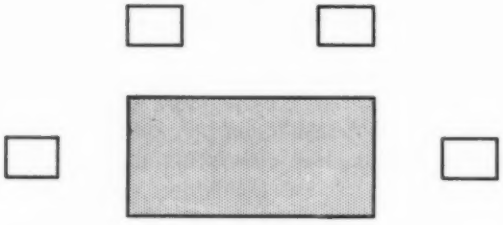


FIGURE 2.

Following the early Persian Wars, Greek history is one long chronicle of civil wars among the several City-States. During these wars we find one of the first examples of an inferior force—in this case, Thebes—emerging victorious over a superior force—Sparta—because of the brilliance of an individual leader expressed in the form of radically new tactical concepts. In this instance the leader was Epaminondas, a Theban general who conceived the oblique order of battle.

The formalized battle tactics of Epaminondas' day invariably resulted in the two opposing forces confronting each other in parallel order with the best troops of each side posted on the right. Cavalry was a distinctly inferior arm and played a small part in these battles. When present, it was usually formed on the wings after the preliminary skirmishing was over.

Epaminondas conceived the idea of massing an overwhelming force against the hostile right flank, while initially merely holding with his own center and right. By delivering his main blow against the enemy's right flank, he

hoped to eliminate that part of the hostile force most capable of counteracting the effect of his unusual tactics. Figure 3 shows the formation of the opposing forces at the battle of Leuctra. For this battle Epaminondas increased the depth of his phalanx on the left of the Theban line to 48 men, instead of the usual 12. The shock effect of the heavy

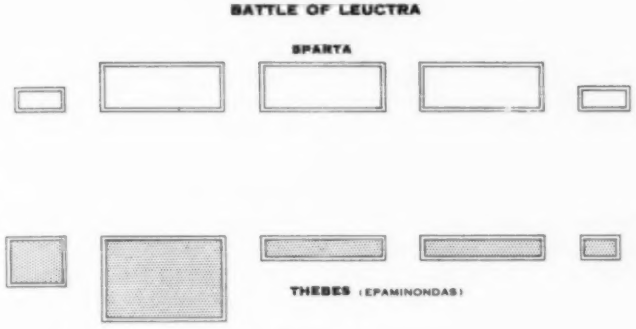


FIGURE 3.

and compact formation was irresistable; the right of the Spartan line crumpled under the impact of the blow, and the victorious Theban left then attacked the Spartan center from the flank and rear. The successive advances of the Theban center and right completed the victory.

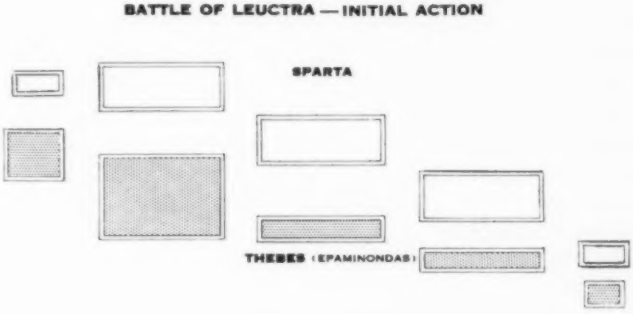


FIGURE 4.

Epaminondas' tactical concepts are much more important than the results of his victory. The oblique order of battle was a fine example of the application of the principle of mass, and has been acclaimed by some historians to be the most important single step in tactical development in the long history of war.

ALEXANDER THE GREAT

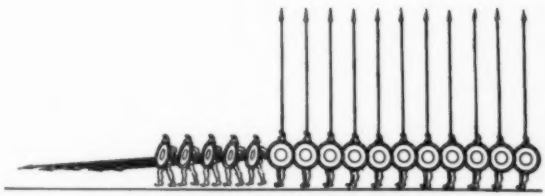
Alexander's title "The Great" actually belongs to his father, Philip, as well as to himself. While Epaminondas was routing the Spartans at Leuctra, Philip, a barbarian chieftain of Macedonia, was a hostage of Thebes. He was profoundly impressed by Epaminondas' tactics, which he studied in great detail. While a prisoner he drafted the plans that were to inject into the evolution of tactics the first concept of methodical warfare.

When released by Thebes, Philip returned to Macedonia and became king. Immediately he put his plans into effect; he completely reorganized the Macedonian army along the lines of the Theban pattern, and despite the fact that Macedonia was a considerably poorer and less populated country than the Greek City-States, he succeeded in conquering all Greece. While preparing to invade Persia he was assassinated.

Alexander, who was twenty years old at the time, succeeded Philip and continued his military reforms. He consolidated his control of Greece by crushing a Theban revolt with the same swiftness and thoroughness that characterized all of his later campaigns. He prepared for the invasion of Persia.

Of all the reforms instituted by Philip and Alexander, by far the most important dealt with the phalanx. They increased the number of ranks from twelve to sixteen and armed their men with 24-foot spears, called sarissas. In combat the sarissas of the first five ranks were levelled so that they formed a five pointed hedge in front of the leader of the file. The men in the rear ranks carried their spears upright, gave weight to the mass, and were used as replacements for tired or wounded men in the front ranks. (See

figure 5.) The soldiers wore partial armor and carried large shields. Alexander's phalanx consisted of 4,000 hoplites, or heavy infantrymen, with 2,000 light infantrymen attached for skirmishing to the front and protecting the flanks.



Position of Sarissas in Battle Order.

FIGURE 5.

Actually, Alexander inherited from Philip the first scientifically organized army that Europe had ever known. In lieu of the usual citizen army, a small standing army was substituted and organized into companies, battalions, regiments, etc. A staff was introduced, special type units were organized, and the first real supply train, including specialized elements such as ponton trains, was formed.

Cavalry was improved and its proportion to infantry was increased to one-sixth, and at times, one-fourth. Artillery was made more effective and transportable. A complete seige train of arrow-firing catapults, stone-throwers, and battering rams was organized and was used extensively in seige operations. Upon one occasion the seige train was employed in the manner approved for modern supporting weapons. When forcing a crossing of the Jaxartes River, Alexander sent his infantry across under cover of long-range catapult fire.

Changes were also effected in command. Previously, after drawing up an army in the desired order of battle and

completing their plans, generals fought in the ranks like privates. Alexander continued to lead his favorite cavalry unit in battle, but kept himself free to control and direct his entire army. To minimize loss of control in the heat of battle, he developed the practice of briefing thoroughly all subordinate commanders.

In the realm of tactics, strengthening the phalanx made it a veritable fortress; increasing the interval between the men added flexibility to the formation. Alexander used his phalanxes as a holding force—an impenetrable defensive front—while he used his cavalry on the flanks as a mobile striking force. Thus he visualized fighting two battles concurrently—one defensive and one offensive. In recorded history he was the first to follow the principle: March divided and fight united. He was the first to use a reserve. He was the first to press a pursuit vigorously—to push the attack until his enemy was destroyed. He once moved his army 400 miles at the rate of 36 miles per day; on another occasion he moved it 135 miles in 72 hours.

In a series of campaigns conducted over a period of 12 years, Alexander conquered the known world. In 334 B.C. he led his army of 30,000 foot troops and 5,000 mounted troops across the Hellespont and invaded the Persian Empire ruled by Darius. In the battle of Arbela, he completely crushed Darius' army—which was at least ten times as large as the Greek force.

The battle of Arbela is history's first instance of the withholding of a reserve. Against the advice of his staff Alexander drew up his army for a pitched battle. As usual, he placed the phalanx in the center and the cavalry on the wings, with hinges between the two arms as shown in figure 6. Behind each wing, he posted a reserve flying column, consisting of cavalry and light infantry. The reserve columns were in position to counter an envelopment by the enemy, or if the enemy did not attempt an envelopment, the columns were in position to wheel inward and reinforce any weak point in the line. Still further to the rear, Alexander constituted a second reserve of infantry to guard the camp.

When he committed his wings, Alexander planned for victory—not mere survival. The right, led by himself, was to be the instrument of attack. The left, aided by the phalanx, was to halt the enemy's attack. Thus he intended to fight two battles—one defensive and the other offensive.

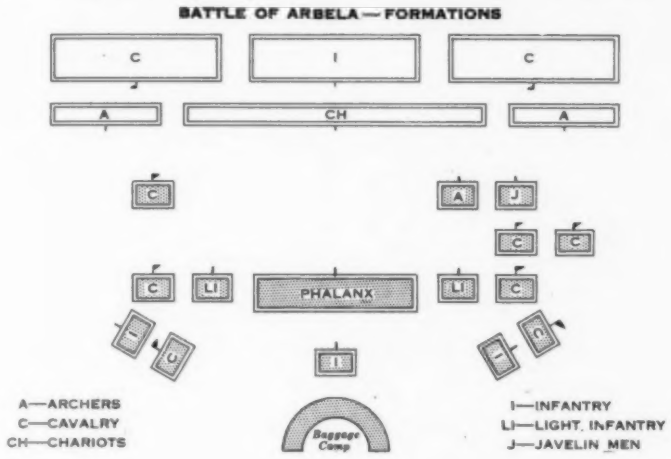


FIGURE 6.

When the battle began, Alexander made a rapid thrust at the Persian left. Because Alexander's forces were formed on a narrow front, this movement brought most of his right wing units opposite the Persian's left wing. (See figure 7.) Darius, fearing that he might not be able to use his chariots, ordered them to charge. His order came too late; the Macedonians were already deployed across the battlefield with their right wing far in advance of their defensive left wing. Alexander's oblique front made his forces less vulnerable to shock effect, and his archers and javelin men were able to destroy the Persian chariots. Alexander's forces then resumed their attack against the Persian left, and the battle entered its second phase.

In this phase, all of the strength of Alexander's right moved forward in a supreme effort while his left and center struggled against superior forces. The crisis came when Alexander drove so deep into the enemy's left-center that Darius and his nobles took flight. The bulk of the Persian host kept on fighting stoutly, and the issue re-

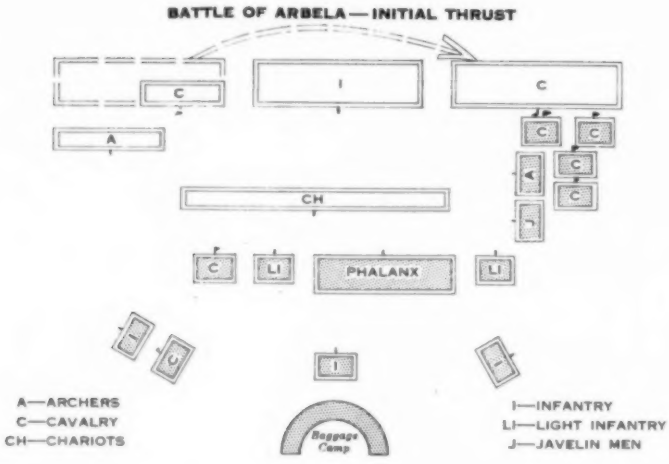


FIGURE 7.

mained in doubt until Alexander's right finally cut its way through. Alexander then wheeled inward and struck the flank and rear of the Persian infantry masses. (See figure 8.) A panic soon spread through the Persian ranks, resulting in a rout of the Persian army even though it still retained a great numerical advantage. Historical accounts indicate that between 300,000 and 400,000 Persians were killed.

After the battle of Arbela, Alexander, in a series of brilliant campaigns, consolidated the vast Persian Empire. He extended his sway over numerous outlying barbarian provinces and successfully invaded India.

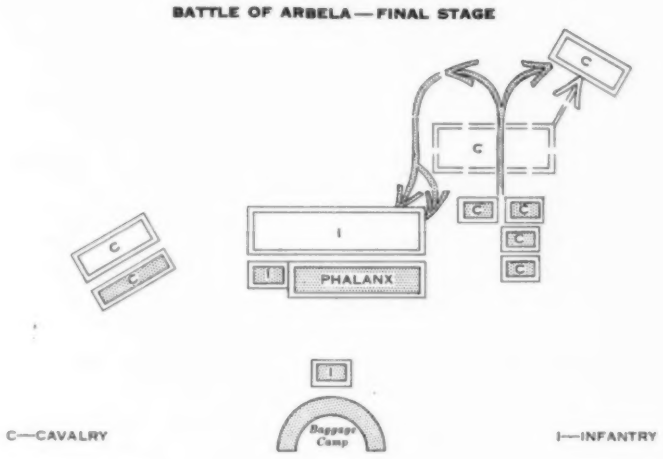


FIGURE 8.

The battle of the Hydaspes River highlighted Alexander's Indian campaign. Applying his new tactical concepts to the crossing of this river, he displayed a technique which closely resembles modern methods. After carrying out elaborate measures to convince the enemy that he did not intend to launch an assault across the river at that time, Alexander moved twenty miles upstream at night and made a successful surprise crossing with a force of 6,000 infantry and 5,000 cavalry. Porus, the Indian commander, moved to meet Alexander with a force estimated at 30,000 infantry, 4,000 cavalry, 300 chariots, and 200 elephants. Alexander's cavalry began the action by enveloping the hostile left flank. (See figure 9.) This maneuver drew the cavalry from the Indian right flank to the support of its hard-pressed cavalry on the left, leaving the right and rear

of Porus' line exposed. Alexander's left flank cavalry then moved against the exposed Indian right flank. While the Indian forces were wholly occupied by successive charges of Alexander's cavalry on their flanks, the phalanx moved forward against the Indian center. The result was a complete and decisive victory for Alexander.

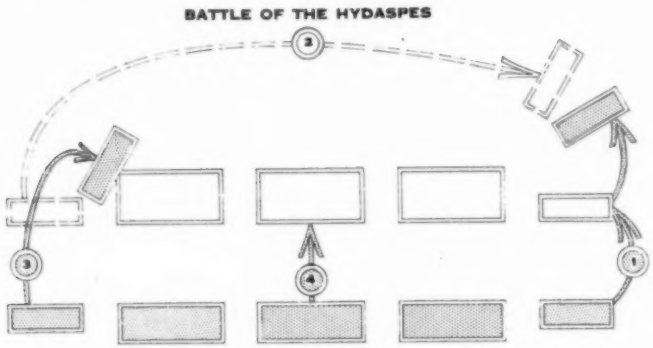


FIGURE 9.

In attempting to evaluate Alexander's accomplishments, one must realize that he was the first authentic exponent of methodical warfare. His movements were always in accordance with a well conceived plan and were always directed toward a definite objective. His advances, despite their speed, always provided for the security of his flanks and rear. The vigor and relentlessness of his pursuit have seldom been surpassed. He was a master of logistics; in all of his long campaigns there were few instances of supply failure. Napoleon said of him, "The campaigns of the son of Philip were not like those of Genghis Khan or Tamerlane—a simple eruption, a sort of deluge. All [of Alexander's] were calculated with care, executed with audacity, conducted with wisdom."

HANNIBAL

In the years following Alexander's death, many new instruments of war were developed: a listening device to

detect mining, catapults effective at a range of 800 yards, cart-transported catapults that could be fired over the heads of the animals, and arrow guns capable of firing arrows in quick succession from a magazine. Thus the stage of world conquest was set for a new military leader who could combine the developments in weapons with the lessons of Alexander's campaigns and produce new tactical concepts. First, however, the Punic Wars had to be fought to determine whether Rome or Carthage was to rule the Mediterranean world.

In the Second Punic War, Hannibal—a young man of 26—led a Carthaginian army of 60,000, through Spain and France, across the Alps, and into northern Italy. The dangers, difficulties, and hardships encountered in this march may be best judged from the fact that Hannibal's army reached the Po Valley with but 26,000 men of the original army of 60,000.

The Romans were ill-prepared for such a daring invasion. At the battles of Tribia and Lake Trasimeno, two separate Roman armies were almost completely destroyed. In all her previous history the Roman Republic had never experienced such overwhelming defeat. To meet the crisis Quintus Fabius, often called Fabius the Delayer, was appointed dictator.

Fabius, realizing that he was no match for Hannibal on the battlefield, wisely chose to conduct a delaying and harassing campaign. He took no chance on being drawn into combat with the redoubtable Carthaginians except under conditions so favorable to himself that Hannibal could not afford to risk a battle. His skillful maneuvering greatly restricted Hannibal's operations and interfered with the foraging expeditions which were relied upon to supply the Carthaginian Army.

The Romans, however, were impatient for more decisive results, and in the spring of 216 B. C. elected two new consuls to command the army against Hannibal. These two consuls were exactly the opposite of each other in character. Aemilius was a firm believer in the Fabian tactics;

Varro, on the other hand, was impetuous, headstrong, and anxious to fight.

After considerable preliminary maneuvering, the two hostile armies confronted each other near the little town of Cannae in Southern Italy. The strength of the Roman Army is given at 80,000 infantry and 7,200 cavalry; Hannibal had 40,000 infantry and 10,000 cavalry. Under the Roman system the two consuls commanded the entire army on alternate days. On the day before the battle of Cannae, Hannibal drew up his troops for battle but Aemilius declined to fight. The following day, however, Hannibal, knowing

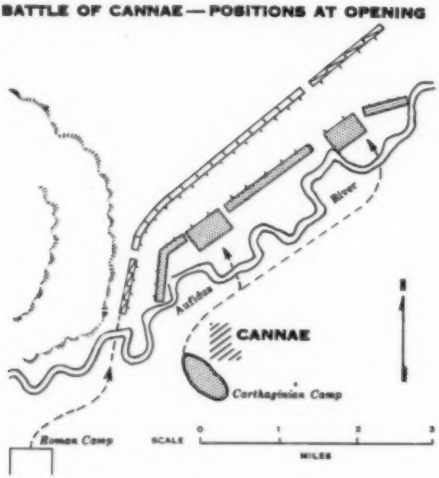


FIGURE 10.

that Varro would be in command, carefully prepared for the great battle by which he hoped to destroy the military power of the Roman state.

On the morning of the battle of Cannae, Varro, leaving 11,000 men in camp, marched across the river and took his position as shown in figure 10. His army was in the customary Roman formation of three lines, but was much more compact than usual, clearly indicating Varro's intention to smash his way through by force. Varro placed himself

with the cavalry on the left and put Aemilius in command of the Roman cavalry on the right. In taking his position, Varro failed to leave sufficient maneuver space for the cavalry under Aemilius. Hannibal carefully noted the disposition of the Roman forces and arranged his own forces to take advantage of every mistake which the overzealous Varro had made.

Hannibal took positions with his left on the river. On his right was his light Numidian cavalry; next was a deep narrow column of heavy African infantry, the cream of

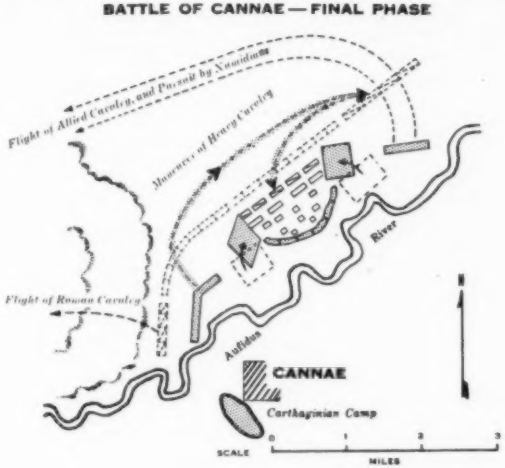


FIGURE 11.

his army; then came a thin line composed of Spanish and Gallic infantry; and next to it, another deep column of heavy African infantry. On his extreme left he placed the heavy Spanish and Gallic cavalry, 8,000 strong.

The battle opened with the usual skirmishing of light troops followed by a charge of the heavy Carthaginian cavalry which swept the greatly outnumbered Roman cavalry from the field. While this was going on the Carthaginian center advanced, thus forming a salient to the front. The light Numidian cavalry, on the right, kept Varro's Roman

cavalry busy by skirmishing tactics designed to postpone the decisive action until the heavy cavalry had disposed of the Roman cavalry on the opposite flank.

At this point the Roman infantry delivered what was expected to be the knock-out blow. The Carthaginian center gave ground to the attack of the Roman legions until the convex Carthaginian line had become concave. Into this bend in the line, the already crowded Legions pushed their way. It was then that the purpose of Hannibal's peculiar formation became evident. The two deep columns of heavy African infantry faced inward and enveloped the Roman flanks. Hannibal's skillful dispositions, coupled with his superb battle tactics and the remarkable discipline of his troops, had resulted in the Roman center being enveloped by a force but little more than half its own strength.

Though crowded and surprised at being attacked from both flanks, the Roman mass might still have cut its way out had not the heavy Carthaginian cavalry, at this moment returning from the pursuit of the Roman cavalry, arrived on the field. Hannibal's heavy cavalry swerved to attack Varro's cavalry which was engaged with the Numidians. The threat alone was enough, and Varro's cavalry scattered without waiting for the Carthaginian cavalry to close. Leaving the Numidians to pursue, the Carthaginian heavy cavalry turned and rode into the rear of the Roman infantry.

The charge upon the undefended rear of the Roman center completed its disorganization. Attacked on the flanks by Hannibals African infantry, and crowded so closely together that the men could not use their arms effectively, the Roman infantry was cut to pieces. The battle became a slaughter; by nightfall the Roman Army of 87,000 men had been destroyed.

The Battle of Cannae is the classical example of the double envelopment. It is even more remarkable in that the envelopment was effected, and the subsequent destruction of the Roman Army was achieved, by a force scarcely more than half the strength of the Romans. As a tactical masterpiece, it stands as a milestone in military science.

Despite these early successes, the Carthaginians could not subjugate the Roman Republic. The latter's advantages were too numerous and too weighty. It is to the everlasting credit of Hannibal that, despite these advantages, the Romans were able to win the final victory in the Punic Wars only after they had copied his tactics.

After Hannibal, the Roman legion took over domination of the ancient world's battlefields. The legion had a typical battle formation of three lines, which distinguished it from the Greek phalanx and other tactical formations. Its total strength was 4,200 and its flexibility permitted some elementary maneuvering within the organization. The habitual use of the third line only in emergencies or to clinch a victory, produced a reserve, which up to this time had been little used in battle tactics.

When forming a legion, the youngest men were placed in the front ranks and the older men in the rear ranks. The reasoning behind this disposition was that if the battle progressed favorably, the younger men were more effective in routing the enemy, and that the older men, since they did not often become engaged, did not suffer heavy casualties. If the battle turned into defeat, the younger men could withdraw through the rear ranks to a fortified encampment in the rear, leaving the older men to fight the delaying action and cover the withdrawal. This saved the younger men for another battle.

The Roman Army prior to the Second Punic War was essentially a militia organization; legions were raised or disbanded as the occasion required. As time went on the legion became more and more professional in character. Permanent legions were formed, and their men were paid according to an established scale.

The effectiveness of the legion emphasized the role of the infantry. Cavalry became less important, until it was hardly more than a scouting force attached to each legion. Collective fighting was discouraged in favor of single combat; the great shock of the Greek phalanx gave way to a series of shocks in rapid succession. By close coordination of the javelin and the sword, foot soldiers discharged a

flight of javelins and then closed in quickly in hand-to-hand combat. When engaged in campaigns the army customarily stopped its march about noontime and devoted the afternoon to constructing a strongly fortified encampment. In this way maximum effectiveness in the combination of offensive and defensive tactics was achieved and when the enemy accepted combat, the battlefield was not too distant from the defensive encampment. In the event the battle did not progress favorably, the Roman force would retire to its previously constructed defensive position. Greater attention was given to seigecraft and the use of engineers and artillery. Each legion was supported by 70 artillery pieces.

It was with this professional army that Julius Caesar conquered Gaul and later overthrew Pompeii in his struggle for the mastery of the Roman state.

CAESAR

Caesar was a leader of men, and to this quality more than to anything else he owes his position as one of the great captains of history. As a strategist and a tactician he was competent but not remarkable. In both fields he made mistakes which would have shattered his reputation and wrecked his ambitions, had it not been for his indomitable will to conquer, his genius for inspiring men, and the fighting quality of his troops.

Caesar introduced no important innovations in tactics but he made an outstanding contribution in the field of leadership. The care and skill which he displayed in fostering *esprit de corps* among his legions constitutes a striking object lesson to all would-be leaders of men. How well it repaid him is evidenced by the number of near defeats that his legions turned into brilliant victories. Caesar's standard for a veteran legion was exceedingly high. In comparing one of his old legions and a new one, he spoke of the new legion as being composed of very promising young soldiers of only eight years war service.

The professional quality of the Roman Army was intensified under the Roman emperors who succeeded Caesar.

As the years passed, the ranks of the legions were recruited more and more from the barbarian tribes which inhabited the outlying provinces. Patriotism to the Empire became almost nonexistent. Professional standards, backed by the traditions which lay behind the permanent organizations, served to keep the legions at a fairly high state of efficiency for many years despite the fact that the power of the Roman central government was on the wane.

During the entire period 3,000 B.C. to 378 A.D., the importance of infantry steadily increased. Under Alexander and Hannibal, cavalry was used most effectively and contributed materially to their successes, but even with them, it was an auxiliary arm. Infantry ruled the battlefield and its supremacy was undisputed. In the realm of tactics, this period witnessed developments of major and lasting importance. (See figure 12.)

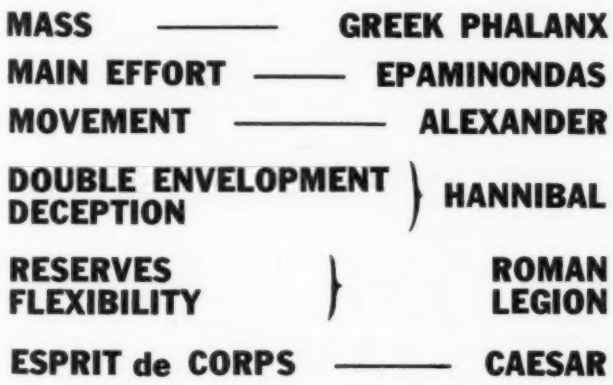


FIGURE 12.—Military concepts evolved during the Age of Valor.

Ancient warfare ended with the battle of Adrianople in 378 A.D. In this battle the mounted barbarians from the north crushed the Roman legions and spelled the downfall of infantry supremacy. This astonishing event was due to two causes: first, to the appearance of stirrups and saddles,

which permitted horsemen to wield their weapons more effectively, and second, to the decline of discipline in the Roman legions, who no longer stood firm before cavalry charges. Rome, henceforth, relegated her infantry legions to auxiliary roles, and mailed horsemen assumed the burden of imperial defense for the few decades which still remained before the Dark Ages closed in.

II

The Middle, or Dark Ages which followed the barbarian invasion were essentially a period of retrogression. The highly trained professional army of Rome was replaced by bands of brave but undisciplined feudal militia. Military supremacy generally went to the strongest wielder of the battleaxe. Ten centuries were to elapse before the evolution of tactics was to be picked up where Hannibal and Caesar left off.

The frequent and bloody wars which filled the thousand years beginning in 378 A.D. were very much of the same pattern. Mailed knight charged mailed knight, and ill-armed serfs, who composed the infantry, were either unarmored archers or swordsmen who exerted little influence on the outcome of a battle.

A mailed knight's suit of armor averaged from 100 to 140 pounds; fighting in such equipment resulted in a test of strength rather than skill.

The most important wars of this period were the crusades in which western civilization, after repulsing the Saracen invasions, invaded the East in a series of counterassaults over a period of 117 years, from 1096 to 1213.

It was during the period of the Crusades that Genghis Khan, emperor of the Mongols, emerged from Eastern Asia and conquered and destroyed much of the civilization of the East. His armies, like those of Europe, were composed almost entirely of mounted men. Genghis alone, of the military leaders of the Dark Ages, developed a system of strategy and tactics.

The movements of his squadrons of cavalry on the battlefield were controlled by black and white signal flags.

FIGURE 13.

Genghis Khan's troops, because of their precision, concerted action, and amazing mobility, proved superior to troops who were better armed and more numerous. To gain superiority of force at the striking point, which is the ultimate aim of all battle tactics, the Mongols made use of ruses and stratagems. They would employ diversionary forces to the front of an enemy and then attack his flanks with the bulk of their forces. They would feign a retreat and then quickly return to the attack, catching the enemy unprepared. Using such tactics, the armies of Genghis Khan were able to conquor half of the known world, subduing all the area between the Pacific and the Danube River.

After the Crusades and the decline of the Mongols, infantry again became the basic fighting arm. At Crecy, Poitiers, and Agincourt the flower of French chivalry learned that mailed cavalry could not charge with impunity against infantrymen armed with an effective missile weapon such as the English long bow.

Early in the 15th century English knights began to fight on foot to provide protection and support for the unarmored archers. English infantry tactics were purely defensive, since dismounted knights in heavy mail could not develop mobility or shock action on the battlefield. The French knights of chivalry often charged blindly toward the immobile English mass, without the slightest attempt at maneuver, and were destroyed by the English archers before they could come to close quarters.

The superiority of the English longbowmen over the mounted knights was not common to other infantry forces of the age. The feudal infantry was regarded as merely a collection of low-born serfs. Sometimes, as at Crecy, they were armed with the longbow and played an important part in the battle. More often they did nothing, or even ran away before battle was joined. French knights, in several instances, charged their own infantry when the foot soldiers were about to gain a victory, alleging that it would be a blot of dishonor on the escutcheon of the hostile cavalry to be beaten by lowborn infantry.

THE RENAISSANCE

The period of the Renaissance marked the first important tactical innovation for almost a thousand years. When King Charles VIII of France invaded Italy in 1496, his army was equipped with heavy artillery pieces mounted on carriages so that they could be moved with an invading army. (Although gunpowder had been invented for over two centuries, its principle use at this time was in heavy cannon designed to breach the walls of castles and cities.) Charles VIII had also acquired 20,000 Swiss infantry mercenaries whose system of fighting sounded the death knell

for the age of chivalry. To oppose armored knights, the mercenaries employed eighteen-foot pikes. They formed for battle in huge squares of three to five thousand men, with their pikes four deep, protruding on all sides. Their formation was remarkably similar to the Greek phalanx, and as long as the Swiss square remained firm, the armored cavalry could not penetrate it. The Square, however, was not merely defensively unbreakable—it could maneuver, if the terrain was favorable. Perfectly disciplined and well drilled, it advanced, wheeled, or retreated without losing cohesion. In the initial campaigns in Italy, the French, with their seige cannon and Swiss pikemen, were victorious everywhere.

When the French were at the height of their success, a Spanish army appeared on the Italian battlefield. A world power at this time, the Spaniards were at first completely outclassed by the French, until they produced a leader who in strategy, tactics, and understanding of the value of organization, was the first soldier of his age.

Gonzales de Cordoba saw in war something beyond merely charging his enemy. When he was weak he stood on the defensive, but only until reinforcements arrived. He employed ruses at every opportunity and took no account of the code of honor which governed the tactics of the knights of the French Army. Throughout his Neapolitan campaigns he logically followed a definite plan. War was to him not a sport but a desperate struggle for victory. Gonzales studied the Swiss methods and recognized the power of their mass phalanx, but he also recognized that the formation was rigid and lacking in firepower. His new Spanish formations were made less dense and more flexible. He was the first leader in modern times to organize a permanent unit larger than the company. Called the Tercia, it was the equivalent of today's regiment. He improved the arquebuses, or primitive hand guns, which had been in use before his time, and introduced the musket—a heavy, hand firearm, which was fired from a rest.

The successors to Gonzales de Cordoba followed the pattern he had set in organization. At the battle of Pavia in

1525, the victorious Spanish unit was composed of two-thirds pikemen and one third arquebuses and muskets.

In the hundred years which followed the battle of Pavia, the Swiss square with Spanish modifications—groups of musketeers at each corner—remained the principle infantry formation. The German Reiter, the best cavalry mercenaries of the era, gave up charging and devised a new tactic. In dense masses they rode at a trot to within thirty paces of the hostile infantry; rank-by-rank they discharged their newly-invented pistols, and then they circled to the rear to reload. This maneuver proved successful against hostile pikemen alone, but not against the musketeers whose weapons had a greater range.

The religious wars in France and Germany and Austria's struggles against the Turks gave ample opportunity to try out new formations and weapons. Of all the wars of this period, however, the sixty-year struggle of the Dutch for freedom from Spanish rule contributed the most to the evolution of tactics. Suffering defeats initially, the Dutch soon produced an outstanding leader, Maurice of Nassau. His innovations placed greater emphasis on discipline and drill, standardization of artillery into a few calibers (although the calibers were still too large for mobility), and distribution of forces in depth. By battle application of these new concepts, the Dutch army eventually won freedom from Spanish subjugation.

The generals of the Renaissance had the military textbooks of Greece and Rome at their disposal, but were burdened with the possession of a new weapon—firearms—which was primitive and only half understood, and to which they had to adapt their tactics. Before a modern Hannibal could appear, the development of firearms and subsequent tactics had to pass through a period of evolution.

In 1618 the Thirty Years' War of Germany broke out and involved all the nations of Europe. The square of infantry, pikeman in the center flanked by musketeers on the four corners, was the prevailing infantry formation. A full day and endless intricate staff planning was necessary to arrange these squares for battle. The pike remained the elite

infantry weapon; artillery was cumbersome, and except in seiges, was definitely auxiliary. The development of the pistol had completely obscured the shock mission of cavalry. Armies rarely exceeded 40,000 men in strength, but carried with them more than twice their strength in noncombatants. The armies lived off the conquered countries. The loot of cities offered some recompense to mercenaries, and a province feared its protecting army almost as much as that of an enemy. It was this period of evolution of tactics that prepared the way for the first of the great captains of modern time—Gustavus Adolphus, King of Sweden.

GUSTAVUS ADOLPHUS

Gustavus became king of the second-rate power, Sweden, in 1611. Immediately, he began his astounding military renovation of the Swedish Army, a renovation which to the student of military history was more important than his victories on the battlefield.

He first did away with the practice of hiring mercenaries and raised by conscription a regular Swedish Army of 20,000 men. He organized a large militia for home defense and used it to fill vacancies in the regular army. He regulated the discipline of his troops by promulgating a remarkable code—a forerunner to modern Articles of War. He organized the first military medical service and the first organic supply service. He originated regimental colors so that he could recognize his units in battle. He standardized his regiments at a strength of 1,200 men divided into eight 150-men companies, each company containing one-third pikemen and two-thirds musketeers. He made his muskets lighter so that they could be fired without a rest, and he developed paper cartridges which doubled the rate of fire.

Since it still required 95 motions for the infantryman to fire his piece, the normal formation to obtain continuous fire was musketeers formed five deep. Pikes were not discarded because a shock weapon was necessary and the bayonet had not been invented. However, it was the musket, not the pike, that was the basic weapon of Gustavus' army, and

for special missions he organized temporary regiments composed entirely of musketeers. In battle, groups composed exclusively of pikemen alternated with groups of musketeers. The pike forces advanced beyond the general line of battle in order to absorb the shock of the hostile charge, and the musketeers covered the massed pikemen with flanking fire.

Artillery was Gustavus' favorite arm. He wanted artillery support on the battlefield, not merely in seiges. To achieve his aim he lightened the guns and developed great numbers of artillery pieces capable of firing 2, 4, and 6-pound shells. His artillery was able to accompany his army on the field and to maneuver during battle. His gunners were able to fire at twice the speed of musketeers.

Gustavus was the first to combine successfully the three arms—infantry, cavalry, and artillery. He used two lines and a reserve and thus became the originator of linear tactics. He employed reconnaissance and pursuit. His innovations were revolutionary and so astoundingly successful that all of the armies of Europe copied his tactics and organization.

THE BAYONET

The latter part of the Thirty Years' War was dominated by France, and produced several outstanding contributions to military science. One of these was the invention of the bayonet. (See figure 14.) Strangely enough, this simple weapon completely altered the existing principles of organization and tactics. Both shock and firepower, so necessary to infantry in battle, were now concentrated in the hands of a single infantryman. The pikeman abruptly disappeared; fire-power became the main tool of infantry, and tactical formations were changed to permit the delivery of fire. Infantry formed in three ranks. Linear rather than mass formations, were characteristic of the new tactics.

FREDERICK THE GREAT

In 1740 Frederick II, usually called Frederick the Great, ascended to the throne of Prussia and immediately initiated sweeping improvements in his army. He laid the

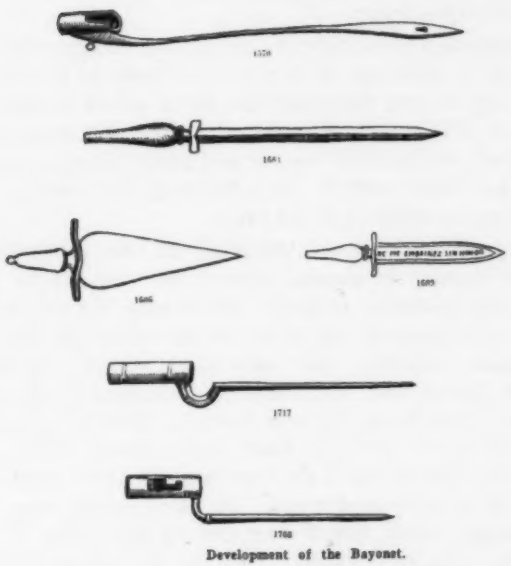


FIGURE 14.—Invention of the bayonet revolutionized infantry tactics.

foundation for Germany's militaristic future and was responsible for making the term "Prussian discipline" synonymous with the expression "iron discipline."

Inheriting a relatively strong army of 80,000, Frederick immediately raised its strength to 100,000. He solved his manpower problems by conscripting soldiers for life. By punishing severely for the smallest offense he gave more stress to discipline than did any other commander of his time. His training was designed to eliminate the human element as far as possible and to reduce the soldier to an automaton, who would respond instantly from fear or from habit.

By demanding vigorous training and unswerving discipline, he trained his musketeers to produce more than double the firepower of any enemy that faced them. He introduced

marching fire—reloading on the move and continuing to fire while advancing.

He improved mounted fire action and taught his cavalry to charge in good order, to increase speed as it neared the enemy, and to rely solely on the shock effect of hitting the enemy at full speed. For morale effect his men charged with a yell, and pursuit was immediately taken up when the enemy had been routed. In reforming, his cavalry rallied to the front instead of to the rear.

He advocated care of wounded on the battlefield and stressed secrecy in tactical operations. He sought always to keep the initiative in battle and impose his will upon the enemy. He favored the attack even when his army was numerically inferior. He advocated attacks against an enemy's flanks and rear, and he attacked frontally only when forced to do so. He was probably the first commander to use howitzers in open field engagements when he employed the high-angle-of-fire weapons to drop missiles close behind steep hills and walls. By eliminating most of the bulky supply train usually carried in the wake of armies of his day and substituting foraging, he achieved a degree of mobility that amazed his opponents.

One of Frederick's favorite battlefield drills was his oblique order, which in his masterpiece, the Battle of Leuthen, (see figure 15) carried him to a smashing victory. The battle began with the Austrians deployed in a defensive position and waiting for Frederick to advance. The first contact, made on the Austrian right, caused their commander, Prince Charles, to heavily reinforce this sector. Frederick, after looking over the terrain and the enemy's lines, decided to use his oblique order formation. Under cover of low hills he sent his army to the right, in two columns, in order to hit the Austrian left, which was obviously the weak portion of their line. This was done and when the Prussians wheeled to the left in perfect battle order and appeared over the low hills, the astonishment of the Austrians matched the precariousness of their situation. Frederick smashed quickly through the enemy's left and proceeded to roll up their line. When Prince Charles collected the remnants of his

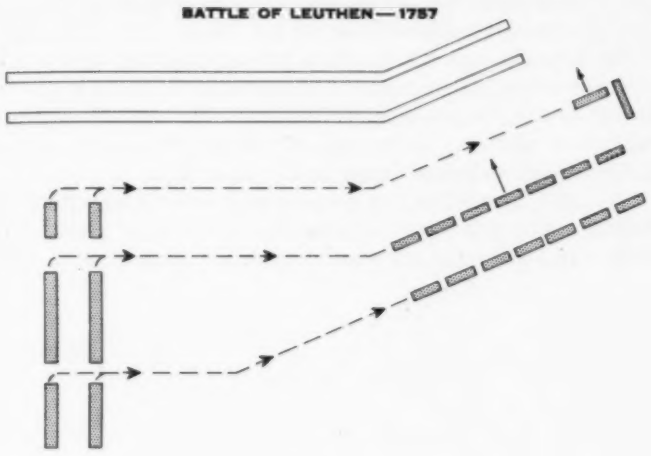


FIGURE 15.

army after this defeat, only 37,000 men remained out of an original army of 80,000. Frederick lost 6,000 of his army of 30,000.

NAPOLEON

As the eighteenth century neared its end, the evolution of tactics had been accelerated to a rapid pace by the development of firearms, artillery, the bayonet, and the new tactical concepts of Gustavus Adolphus and Frederick the Great. The way was prepared for a new leader who could take these advances in weapons and tactics and apply them, with innovations of his own devising, to the battlefield. From this situation, Napoleon Bonaparte emerged as one of the outstanding strategists and tacticans of all time.

Napoleon's domination of the world military scene began in 1796, when he used conscription, as had Frederick, to fill his ranks. He substituted the "spirit of the bayonet" for the harsh Prussian discipline. He organized his infantry into regiments of 2,436 men commanded by a colonel. He divided his regiments into five battalions and his battalions

into nine companies. He equipped his men with the bayonet and thoroughly trained them in its use as a shock weapon. "The bayonet has always been the arm of the brave man and the principle instrument of victory. It is the arm best suited to the French soldier," he said. He used his muskets with fair accuracy at ranges of 150 to 200 yards, and at longer ranges against large bodies of troops.

He used his artillery in greater quantities and with more success than any other commander prior to his time. (See figure 16.) His artillery was horse-drawn, extremely mobile,

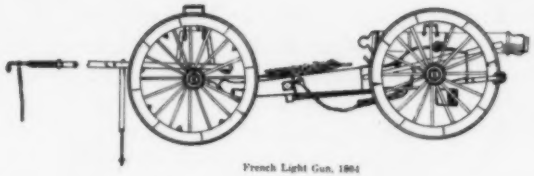


FIGURE 16.—French artillery.

and included 6, 8, and 10-pounders which were effective up to 2,000 yards. His infantry was supported by accompanying guns of 4-pound size. Prior to launching an attack, he massed his artillery a few hundred yards from the enemy's lines and shelled the area through which he planned to make his penetration—in the battle of Waterloo he employed 80 guns in this manner, massing them 600 yards from Wellington's line. Because of the limited range (2,000 yards) of his artillery, it was necessary for him to push his artillery forward closely behind his attacking infantry. This resulted in his artillerymen becoming engaged in close combat almost as often as the infantrymen they were supporting.

Napoleon was the first commander in Europe to introduce the open skirmish line method of fighting. He deployed his line into small columns for maneuver and fire, and, in the Jena campaign, decisively defeated the Prussian armies who employed compact, rigid lines of volley-firing troops.

Napoleon's thoughts on tactics and strategy are condensed into his famous 115 maxims. His tactical precept, divide to conquer, is brilliantly illustrated in the Battle of Austerlitz, where his army of 65,000 faced an Allied army of 80,000.

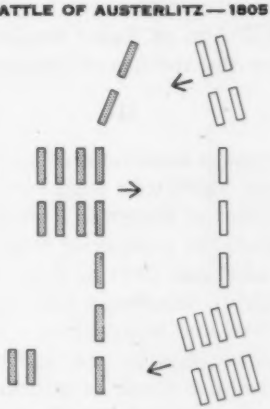


FIGURE 17.

The Allies under the Russian General Kutusoff, attacked the French Army, feinting to the right and making their main assault on the left. Napoleon had studied the terrain, and by massing his strength in the center and leaving his flanks thinly held, had purposely disposed his troops to invite this move. When half of the Allied army had been committed on his left, Napoleon hurled the bulk of his army at the enemy's weak center. He crashed through with ease, splitting the Allies into two relatively helpless halves which he proceeded to defeat one at a time. The allied losses at Austerlitz were 27,000; the French losses 6,800.

The Napoleonic era ended at Waterloo in 1815—not very much more than a hundred years ago! Yet what changes in warfare those hundred years have brought. When we compare the campaigns of Napoleon with those of Alexander and Hannibal, we cannot help noticing that in many ways their methods of war were very similar. Man's only

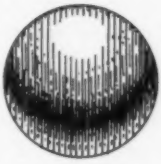
means of going to battle in Napoleon's day was still either on foot or on horse; the two forces usually faced each other across an open plain at relatively close distances; the commanders of the field forces were generally present on the battlefield observing the entire action and controlling the battle by personal intervention when the occasion demanded. About the only radical difference between the Napoleonic campaigns and the Age of Valor resulted from the invention of gunpowder and the use of firearms.

III

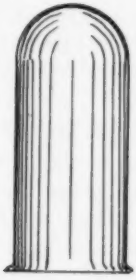
The rapid changes in conditions of warfare, weapons, and military equipment which took place in the 133 years following Napoleon's defeat at Waterloo paralleled the technological developments of the Industrial Revolution. During the century between 1800 and 1900 such inventions as the steam locomotive, steamboat, telegraph, telephone, radio, and airplane were conceived and popularized. As a natural by-product of the achievements in the industrial world, great improvements were also made in military arms and equipment. Although the origin of rifled weapons, explosive shells, and even machine guns can be traced back to the age of Leonardo de Vinci in the 15th century, it was not until the 19th century that man was capable of producing these tools of war sufficiently well to enable them to add appreciably to an army's combat efficiency in the field. Out of the many contributions of the century, two of the most important were the change from round to cylindriconidal bullets, and the development of the percussion cap. (See figure 18.) These improvements reduced the probable number of misfires in 1000 rounds from 411 to 4½. These two inventions made the rifle the most deadly weapon of the 19th century and, consequently, revolutionized infantry tactics.

Development of more powerful weapons however, was not the only factor which stimulated the growth of armies. Under Napoleon armies were quadrupled in size, a trend which was forced on his contemporaries and continued by his successors. It was one of the foremost military philosophers of all time, a capable Prussian officer named Karl

von Clausewitz, who, through a critical study of Napoleon's methods, successes, and failures, reduced to writing the philosophy which has since been included in the war creed of all nations. In his *On War*, Clausewitz states; "A soldier is a fighting man; a nation is a mass of potential fighters; therefore maximum fighting power demands that all men be trained as soldiers."



SPHERICAL BULLET



CYLINDROCONOIDAL BULLET

The Wesley Richards Detonating Gun.

FIGURE 18.

The years after Napoleon's fall witnessed one of the longest eras of peace the continent of Europe has ever known. Except for the revolutionary upheavals in Italy and France in 1848, no major power was involved in war until

1854, when France, England, and Turkey fought Russia in the Crimean War. British and French soldiers were equipped with breech-loading rifles at this time, instead of smoothbore muskets, but, because of poor generalship, they failed to utilize the tactical advantages of the new weapon. The steamboat and the telephone also appeared in war trappings for the first time, but General Simpson, the British commander, complained, "The new means of communication upset everything." In a series of over-cautious campaigns characterized by extensive blunders by all belligerents, the greatest claim to fame belongs to Florence Nightingale for her efforts to obtain care for the wounded.

In the years that followed, industry produced weapons with greater range and with a higher degree of accuracy. The killing effect of these newly-developed weapons made it mandatory that armies of the future be prepared to hide themselves, disperse when under fire, and attack rapidly under cover of the fire of their own weapons, if they were to survive on the battlefield. The tools had been developed and the philosophies of war had been outlined—where would the first major test take place?

THE CIVIL WAR

The world had not long to wait; the test was in the American Civil War. Probably more new weapons and items of equipment were introduced in this war than in any other single conflict—except, perhaps, World War II. Railway and field telegraph at last came into their own. Steamships supplied the armies of both sides. Railway guns, ironclad warships, electrically exploded mines, submarines, repeating rifles, machine guns, barbed wire entanglements, hand grenades, armored trains, balloons, rockets and many forms of booby traps were used during this war, some for the first time while others such as the hand grenade and observation balloon were revivals of weapons long believed to be obsolete.

On both sides skill in leadership reached a new height. Lee, Jackson, and Forrest emerged as outstanding commanders of the Confederate Army, while Grant, Sherman,

and Sheridan were responsible in a large measure for the eventual success of the Union Forces. The men led by both sides were truly citizen soldiers, inspired by the righteousness of their separate purposes.

But it was not because of the introduction of new weapons and the brilliance of leadership that the Civil War merits attention, for before a year of fighting had ended the Napoleonic concept of battlefield technique was greatly altered. Not that Napoleon's strategic planning or his schematic plans of maneuver were outmoded in any way, but his method of attack—successive blows of massed guns, columns of bayonets, and charges of heavy cavalry—was no longer practicable in the face of long-range, rifled firearms. The balance between the offensive and the defensive was restored in this conflict. It is to Lee's credit that he recognized his first mistake when 6,000 Confederate soldiers, ordered to attack Malvern Hill in the best style of a Napoleonic bayonet column, were mown down with relative ease by an inferior force of entrenched riflemen. Some later generals had still not learned this lesson by 1914.

The construction of entrenchments was as much a deciding factor in holding defensive positions as were the weapons of the defender. With many opportunities for practice both Union and Confederate soldiers became adept

FIGURE 19.—The trench system at Petersburg in 1864.

at throwing up log-faced earthworks, and the ax and spade became almost as important to the soldier as his rifle. (See figures 19 and 20.)

FIGURE 20.—A bombproof rifle pit at Petersburg.

General Lee soon realized that a marksman in a trench can take care of several enemy in the open. In the campaigns that followed he based most of his daring maneuvers on his confidence that a regiment in trenches could contain a division in the open. Throughout the war, at Fredericksburg, at Gettysburg, and at Cold Harbor, the defensive power of entrenched riflemen was proved again and again.

Tactics of auxiliary arms were also changed. With the increased range of infantry small arms, the artillery found it impractical to mass its guns in front of the infantry in order to deliver a preparation prior to the charge. The gunners became targets for enemy sharpshooters, and the guns were left unmanned. The artillery was thus forced to take up positions behind the main line of infantry and was relegated to a supporting role. Cavalry tactics, too, felt

the impact of the supremacy of the rifle. Charges by horsemen became suicidal against infantry weapons which could kill at 500 yards. As a result, cavalry was used to reconnoiter for information and to make raids on enemy rear areas.

Although the participants of the Civil War eventually recognized the strength of defensive fire power and the value of entrenchments, European professional soldiers schooled in the principles of the offensive, refused to profit by the lessons taught in America. To bolster their convictions they pointed to the Prussian military machine of Bismarck and Von Moltke. Whereas, in America, the Federal Forces required four years to overcome an adversary who had much inferior material assets, the armies of Prussia concluded two successful wars, each in a matter of weeks, against the defense-minded Austrians and French in 1866 and 1870. Von Moltke summed up current military thought when he dismissed the American Civil War as a "conflict of armed mobs chasing each other around the country, from which nothing could be learned."

Clausewitz' theory of the nation in arms has never been adopted by a more loyal patron than Otto von Bismarck. Under his guidance Germany became truly a nation in arms with the re-introduction of peace time conscription. The German Army became the ruler of the people. The first factories of the machine age were supervised by the army; the first railroads, which in other countries had spread in a haphazard fashion, were controlled by the army with a view toward the rapid massing of troops on any frontier. With an army loyal to the ruler and supported by the people, Bismarck was ready to go to war.

The Prussian war machine, composed of well-trained troops equipped with the needle gun, the first practical breech loading rifle of European warfare, and led by Helmuth von Moltke, the greatest German soldier since Frederick, moved against Austria in June 1866. (See figure 21.)

In a short war which lasted only seven weeks, Von Moltke's highly trained staff solved the intricacies of rail mobilization, while his battlefield leaders insured victory

by adopting skirmish line tactics and using their needle gun to the best advantage. Although the needle gun was outranged by the Lorenz muzzle loader used by the Austrians, the Prussians could load and fire their weapon from any position — and three times as fast. Notwithstanding the suddenness of victory, the German Army still had much to learn; lack of knowledge of the value of cavalry as a reconnaissance agent kept Von Moltke uninformed for forty-eight hours, although he was within a mile of the main

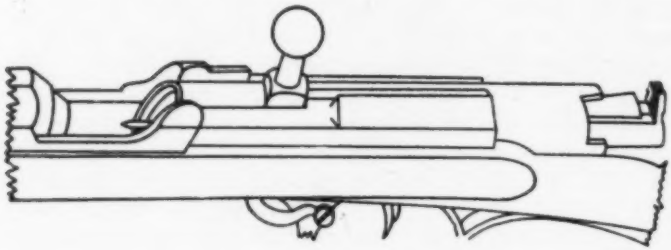


FIGURE 21.—The needle gun.

Austrian army. The artillery organization was poor and their smoothbore pieces were outranged by the infantrymen's rifles.

Close on the heels of Von Moltke's military triumph, Bismarck formed an alliance with Austria, which permitted Von Moltke to turn his full attention to improving his army in preparation for the coming struggle with France. In the four years between the defeat of Austria and the opening of the Franco-Prussian War in 1870, training was greatly intensified, rifled steel breechloaders were made standard in the artillery, and cavalry tactics were revised to place greater emphasis on the reconnaissance mission.

In France, all attempts made by Napoleon III to reform the army, increase conscription, and prepare the nation for war only added to his unpopularity. In spite of the lack of popular support, however, French military inventors had perfected a breech-loading rifle with a longer range and

faster rate of fire than the needle gun. The mitrailleuse, the first practical European machine gun, was also developed and adopted by the French Army during this period. This gun had 37 barrels, was mechanically operated, and could fire at the rate of 1200 rounds per minute. (See figure 22.)

In the six weeks campaign which began in August 1870, Moltke's reference to "armed mobs" in the Civil War

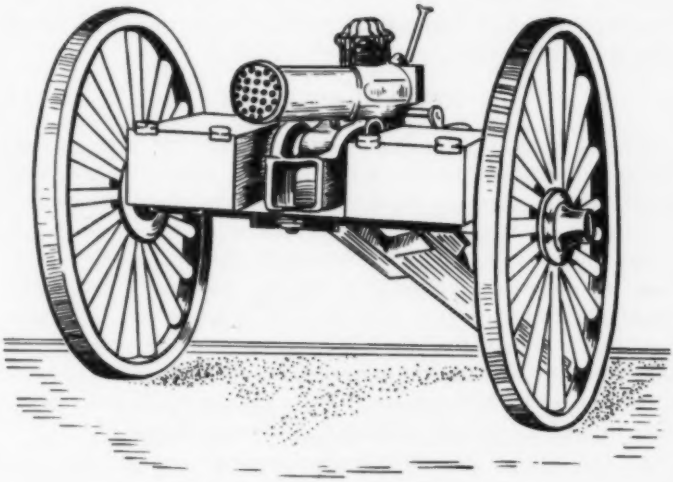


FIGURE 22.—The Mitrailleuse.

would best describe his own forces and the French Army they fought. France's machinery for mobilization broke down so completely that only 220,000 troops reached the frontier, including a regiment which detrained by mistake in a town just occupied by the enemy. The two main French armies were separated, confused, outgeneraled, and beaten in detail by three German armies totaling more than 500,000 troops. The superior staff work of the German commanders enabled them to concentrate more men than the French at the key points in every engagement.

National unpreparedness forced the French field commanders to adopt the defensive. Even the mitrailleuse was

considered a failure because of the tactical error made by the French in using it as an artillery piece because of its heavy weight. The French artillery was neutralized by the Prussian breech-loaders. The reliance of the French commanders on rash bravery, as demonstrated by fierce bayonet charges, and failure to capitalize on the fact that the French soldiers were armed with a superior rifle, resulted in excessive French casualties. The French field commanders ignored the lessons of the Civil War, scorning field entrenchments and defensive tactics believing that they would sap the fighting spirit of an army.

EUROPE IN ARMS

The success of the Prussians over Austria and France forced all Europe to adopt Clausewitz' theory of national mobilization. Armies rapidly increased in size until no nation could be considered a major power unless it could put 5,000,000 men in the field. Although the peace after 1870 was the longest in Europe's history, nations lived under constant threat of war and fear of aggression. Germany continued to set the pace in military development and thought, and Von Moltke himself dispelled any hope of continued peace by expounding, "Perpetual peace is a dream—only in war are man's noblest qualities developed."

As the size of the world's armies continued to grow, increasing demands from the military led to another wave of innovations in military equipment and weapons. The universal acceptance of smokeless powder gave the world's infantrymen a new rifle with a range of about 3,000 yards and a muzzle velocity of 2,700 feet per second. America had the Springfield, Germany the Mauser, Britain the Enfield, each with the same essential features. In a relatively minor skirmish against the Boers in South Africa at the turn of the century, the British Army renounced a traditional policy by adopting a khaki colored field uniform which blended with the terrain. Here, also, the field telegraph was extensively used, even by small units. On the other side of the world in the war between Japan and Russia in 1904, other weapons appeared on the battlefield. Both

the Japanese and the Russians used with great success machine guns originally designed by Americans. For communications the Japanese used a field telephone system on land, and Marconi's wireless at sea. In Europe, the French produced a 75mm gun with a hydropneumatic recoil system, while the Germans improved their heavy artillery, mortars, and machine guns. Before World War I broke out the Germans had over 1,000 military airplanes in service.

WORLD WAR I

On June 28, 1914, the assasination of Archduke Ferdinand of Austria touched off a chain of explosions. Within a few weeks Europe was engulfed in war. The leading military analysts of the continent, still impressed by the swift victories of Prussia in 1886 and 1870, believed that the rapid strides made in the production of weapons and mobile equipment would further increase the swiftness of attack and thus shorten the course of war. Count Alfred von Schlieffen, former chief of the German General Staff, had in 1905 formulated a plan for rapidly crushing France. Although it was modified by his successors, Von Schlieffen's plan was used in 1914. The plan called for making a massive turning movement pivoted on Switzerland and driving an overwhelmingly strong right wing through neutral Belgium into France. Counting on the French to expend their main effort against his left and center, Von Schlieffen planned for the enveloping force to sweep west and south of Paris and move against the rear of the main French armies. (See figure 23.)

The plan was initially successful and might have been executed but for two factors. The first was the premature optimism of the German commander, the younger Von Moltke, nephew of the leader of 1870. Encouraged by the early reports of his field commanders, Von Moltke detached 11 divisions from his strong right wing to send against Russia and then directed that the remainder of the enveloping forces move east of Paris. The second reason for the failure of the German attack was the tenacious resistance of the French Army on the Marne River. As the German right wing moved north of Paris, General Gallieno, military

governor of the city, deduced from the reports of French aviators that the German flank was exposed. Using the telephone, he persuaded Marshal Joffre to strike the exposed flank promptly. General Gallieno then moved the French Sixth Army by taxicabs commandeered on the streets

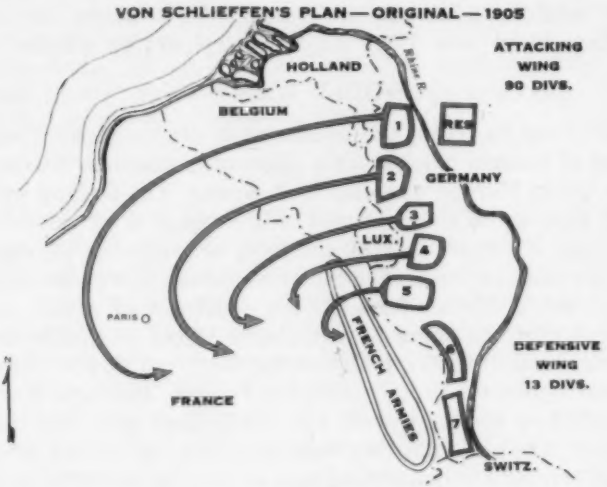


FIGURE 23.

of Paris to the scene of the battle. The French counter-offensive was successful and forced the Germans to retreat to the Aisne River to reorganize their scattered columns. (See figure 24.)

The battle of the Marne was followed by a race to the sea as each army tried to outflank the other. When the sea was reached in Belgium two massive armies faced each other on a continuous front from Switzerland to the English Channel. Room for maneuver had disappeared. On the eastern front a similar situation existed.

In spite of the trench system that zigzagged across the front, commanders of the engaged armies still could not comprehend the new situation. The French leaders believed that the key to victory was to be found in the combination

of artillery preparations and frontal assaults with the bayonet. Justified by the potential 2 to 1 superiority of the Allies in manpower, French tacticians believed in a campaign of attrition.

The Germans on the other hand, were able to compensate for their manpower shortage by the efficiency of their strategic railroad net, which allowed them to shift troops rapid-

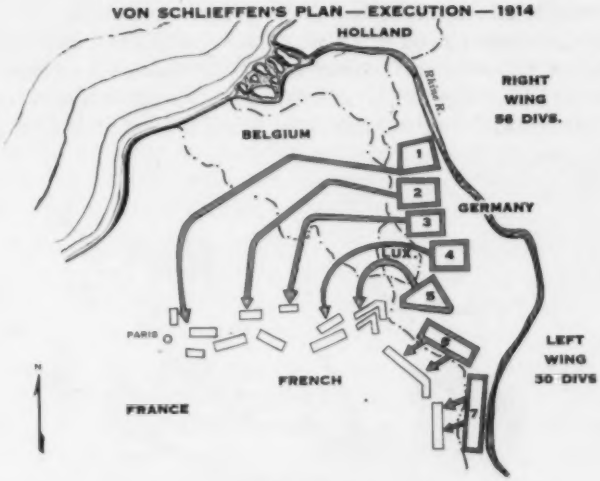


FIGURE 24.

ly from one section of the front to another. The German output of arms and ammunition was greater than that of all the allies combined; and the German army soon demonstrated that the machine gun meant more on the modern battlefield than courage and bayonets.

Finally, in belated recognition of the strength of defensive firepower, the German high command prescribed the defensive tactics which let the enemy wear himself out in an attempt to gain a few yards.

The western front became a stalemate. From December 1914 until March 1918, except for a voluntary retirement by the Germans from the Somme salient, the lines did not

shift as much as ten miles. Several new weapons were introduced during this period, but the skepticism of the old guard commanders prevented them from being fully exploited. England was first bombed from the air in December 1914, but the damage was negligible. The Germans introduced gas in April 1915 but failed to take advantage of its surprise effect. Within a few weeks the Allies equipped their troops with masks and were using gas themselves; as a result, gas warfare had little effect on tactics.

The Germans placed machine guns on airplanes, and until the Allies followed suit a year later, maintained supremacy of the air. (See figure 25.) Aerial combat became a new method of warfare, but, in itself, had no effect on the tactics of

FIGURE 25.

ground troops. The increasing use of aerial photography, however, improved intelligence services and led to the need for the concealment of important concentrations and movements.

In this period of deadlock, artillery and machine guns were the most effective weapons. Artillery was particularly valuable in delivering preparations preliminary to attacks. Such preparations sometimes lasted as long as two weeks; the disadvantage, of course, was that these prolonged preparations forewarned the enemy and afforded him ample time to shift his reserves to meet the inevitable assault. The artillery of World War I, however, had a major weakness—lack of mobility. Pneumatic tires that were strong enough to move even the light field pieces did not exist. Steel wheels on the carriages of that period would quickly destroy even the best roads. Cross-country movements for any distance were out of the question. As a result, continuous artillery support for attacking infantry was impossible. Despite these handicaps, artillery accounted for 85 per cent of all casualties.

On the defense, the machine gun was the infantry weapon that assumed primary importance. While units were actually attacking, defensive machine guns caused far more casualties on the assault echelons than artillery.

The tank was the surprise weapon of World War I. In November 1917, 381 British tanks supported by infantry burst out along a six mile front and gained 7,000 yards through German positions designed to hold up an Army for months. Only a limited number of tanks were available, however, and the Allies were unable to capitalize fully on the surprise effect of their new weapon.

In the spring of 1918, the long deadlocked front sprang to life. The Germans again made the first move, and, resurrecting the ancient principle of infiltration under the new name of soft-spot tactics, they scored smashing successes in a series of offensives which carried them to within twenty-seven miles of Paris. The new tactics relied on surprise and speed to send men and weapons through the enemy lines while bypassing organized points of resistance.

The Allies however, bolstered by the newly-arrived American Army, had a few new tactical tricks of their own. Behind creeping artillery barrages, infantrymen advanced to

the point of contact. Machine guns, heretofore considered defensive weapons, were used offensively. Infiltration tactics were adopted by the Allies, and the American Army, trained in the principles of open warfare, followed their attacks with vigorous pursuits which kept the enemy reeling. British mass tank attacks of up to 450 tanks were universally successful, for no effective antitank weapon had yet appeared on the field. Toward the close of the war the airplane, too, was given a tactical role with the introduction of ground strafing of enemy columns and bombing attacks on enemy stores and troop concentrations.

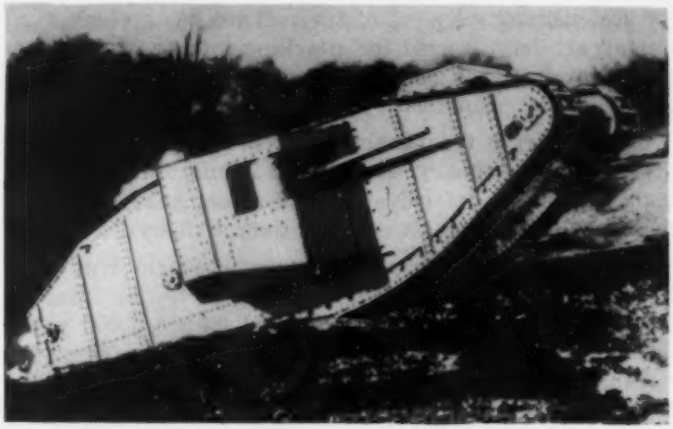


FIGURE 26.—The British Mark VIII tank.

Had the Germans not sued for peace in November 1918 it is possible that the world might have seen modern blitzkrieg warfare executed by the Allies the following spring instead of by the Nazis twenty years later.

In the strategic plan for the invasion of Germany in the spring of 1919, Major General J. F. C. Fuller, leading British tank tactician, outlined a plan whereby hundreds of fast tanks supported by bombing planes would smash through the enemy lines, surprise rear installations, and cut vital communications. Armored infantry would follow closely to exploit the break-through. Concurrently, the

American General, Billy Mitchell, had secured General Pershing's support for a plan to train and equip 12,000 parachutists, who were to be ferried across the lines in 1,200 bombing planes and were to be dropped behind the fortress of Metz to attack it from the rear at the same time that an assault was launched from the front.

Following World War I the Allies adopted a defensive attitude and placed their faith in extensive fortifications such as the Maginot Line. The Germans correctly determined that the tank and the airplane had rendered such defensive lines obsolete. On the other hand, defensive weapons had not kept pace with offensive arms. The rifles and machine guns of 1939 were essentially the same as the weapons of 1918. Antitank guns and antiaircraft guns were constantly being outmoded and rendered obsolete by the latest change in armor and aircraft.

The testing ground for the new weapons was found in Spain in 1936. When the Germans found that their fast, light tanks were too vulnerable to the 37-mm antitank gun, they changed over to heavily armored medium tanks. They learned that Stuka dive bombers could furnish suitable air support for their fast moving columns of tanks. They learned that fear is a powerful weapon when applied against the civilian populace. They learned that fifth columnists and spies operating within the objective territory are a valuable asset to the aggressor. Once again the Germans took advantage of a period of general peace within the world to bring the development of tactics abreast of the development of weapons.

Armed with the knowledge gained in their tests in Spain, Germany could hardly wait to move against Poland. In September 1939, in a campaign which lasted no longer than three weeks, the mighty Wehrmacht executed a classic double envelopment which completely eliminated the Polish Army. A German air force of 5,000 planes destroyed most of the Polish aircraft on the ground and neutralized routes of communication to isolate the battlefield for the ground troops. Although many military men were disturbed by the remarkable success of Blitzkrieg tactics as executed in

Poland, the military leaders hopefully clung to their faith in elaborate defensive positions such as the Maginot Line. With command of the sea in their hands the Allies thought that they could eventually starve the Axis into submission.

In April 1940, Germany virtually absorbed Denmark and Norway after fifth columnists had prepared the way. Less than a month later they launched an offensive against Holland and Belgium. By a combination of fifth column activities, air bombardment, and parachute attacks, the aggressors drove through Holland and ejected the Belgians from their forts along the Albert Canal. The British and French,

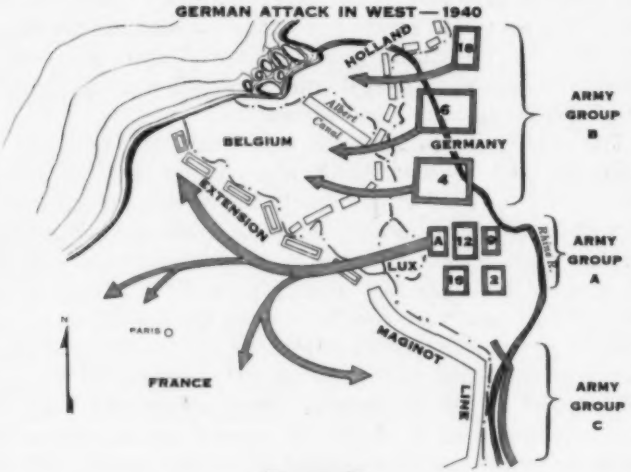


FIGURE 27.

recalling Von Schlieffen's turning movement of World War I, rushed their main forces north to the aid of the Belgians. This was exactly what the German General Staff had hoped for. The main attack led by General von Rundstedt and spearheaded by tanks, broke through the Ardennes, farther to the south and in the rear of the advancing Allies, and proceeded to attack the separated forces. A brief period of British air supremacy made it possible to evacuate about 350,000 troops from Dunkirk, but left the Germans as the undisputed victors.

After failing to gain air superiority over England in the fall of 1940, the Germans abandoned their attempts at invasion and turned their attention to the East. After another successful blitz in the Balkans, Russia was invaded in June 1941. Initially, the Germans moved with characteristic swiftness, and, to all outward appearances, the Russians were soon to follow the fate of France, Poland, Belgium, and Holland. In contrast to the democracies, however, Soviet preparations had kept pace with blitzkrieg tactics, and although the Russians lost the initial battles, they evolved a new tactical concept in time to prevent defeat.

Heretofore, defenders surrounded by superior German forces had capitulated rather than suffer annihilation; the Russians continued to fight as long as they had ammunition and supplies. When these were exhausted the troops organized into small marauding bands and adopted guerilla tactics. Roving bands of Russians repeatedly disrupted the German line of communications, attacked isolated supply dumps and garrisons, and interfered with German operations. After piercing the Russian frontier, the German timetable fell far behind schedule. It appeared that the Russians had developed a counter tactic to lightning war.

When America entered the war after the attack on Pearl Harbor, potential superiority in men and materiel rested with the Allies; however, the initial successes of the Japanese raised doubts as to whether that potential would ever be realized. Singapore, the East Indies, and the Philippines fell in rapid succession to Japanese attacks. Where the Germans relied on the combination of tank and plane, the Japs relied on infiltration tactics, amphibious landings, and ability to negotiate difficult terrain.

Until the fall of 1942 the Germans and the Japanese were successful almost everywhere. The years of study devoted to the tactics of previous wars were paying dividends. Few new weapons appeared and the aggressors had shown mastery of all of the old ones. The airplane appeared to be vulnerable to superior airplanes, and the Germans had proved that their tanks were years in advance of Allied

armor. Again it appeared that the Germans had developed their tactics in balance with their development of weapons.

MODERN WARFARE

The next three years witnessed a series of developments climaxing in the destruction of a city by a single atomic bomb. Tactical concepts were put to the test of airborne and seaborne invasions. Troops sweltered in temperatures of 120 degrees in one theater and froze at -40 degrees in another. Twenty-ton tanks encountered eighty-ton tanks, and both fell prey to an infantryman armed with a four-foot tube which discharged a 6-pound rocket. Aircraft were capable of flying more than 500 miles an hour; other aircraft hovered vertically overhead. Not merely a single nation, as visualized by Von Clausewitz, but most of the civilized world was mobilized and converted into an arsenal.

By historical standards it is much too early to draw a series of tactical concepts based on the events between 1942 and 1945. The one indisputable fact is that the Allies were victorious. All other premises are subject to interpretation. No one can guarantee what might have resulted if Von Runstedt had been successful at the Bulge or if MacArthur had decided to bypass the Philippines.

Many of the newly-developed instruments of war necessitated changes in tactics. During the war such changes were effected on a trial and error basis—any solution that worked was acceptable. The fact that the Allies were successful in gaining the tactical decision, however, does not necessarily indicate that their tactical employment of newly-developed equipment was the ultimate solution. Reflective study based on experience and experimentation has already indicated that some of the tactical concepts rapidly formulated during the war were not sound. The reorganization of the Ground Forces of the U.S. and the British Armies stands witness to the fact.

It now appears that the development of weapons is preceding the development of tactics; science and industry have combined to produce instruments of warfare with totally new characteristics, but doctrine governing the tactical employment of these instruments lags far behind. The tactical significance of the atomic bomb, bacteriological warfare, and supersonic aircraft is still in the speculative stage.

Technique of Direct Fire, 57-mm and 75-mm Rifles

Previous articles in THE MAILING LIST *and the* INFANTRY SCHOOL QUARTERLY *have covered mechanical training for both 57-mm and 75-mm rifles, preparatory marksmanship and marksmanship training for the 75-mm rifle, subcaliber training with the 75-mm rifle, tactical training for the 57-mm rifle section and the 75-mm rifle platoon, and forward observation for infantry weapons. This article rounds out the presentation of training material and methods applicable to the 57-mm rifle section and the 75-mm rifle platoon.*

The proper and effective application of fire on a target is called "technique of fire." The operation involved in pointing a gun for direction and elevation by directing the line of sight on a target visible to the gunner is called "direct laying." Since the primary mission of the 57-mm rifle and the 75-mm rifle is to engage point targets with direct fire, this phase of technique of fire is particularly important.

It should be understood at the outset that training in marksmanship is a prerequisite to instruction in technique of fire. In order to properly apply fire on a target with the maximum speed and effect, the following points should be thoroughly understood:

Characteristics of fire.

Range, speed, and lead determination.

Target designation.

Fire control.

Fire commands.

CHARACTERISTICS OF FIRE

A knowledge of characteristics of fire assists the leader in determining whether or not it is worthwhile to engage a particular target, whether it is safe to friendly troops to engage such a target, and the dispersion pattern that can be expected when firing at different ranges and on varying terrain.

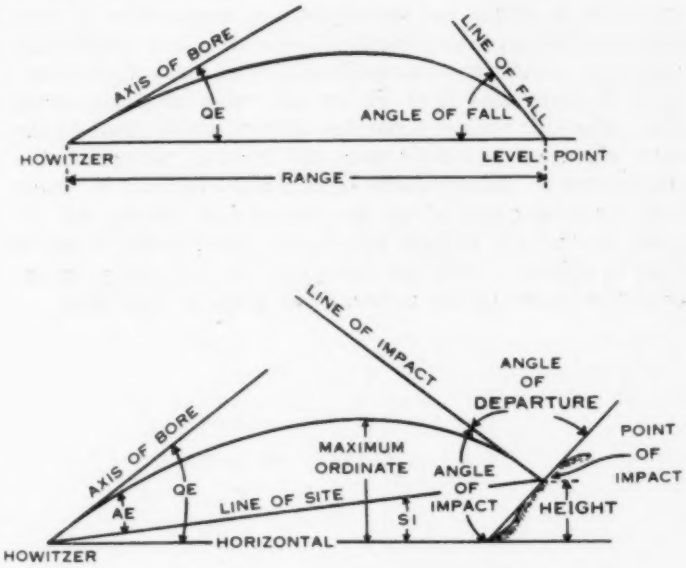


Figure 1.—Elements of trajectory.

The path followed by the projectile from the gun to the point of impact is known as the trajectory. Although the 57-mm and 75-mm rifles are classed as flat-trajectory weapons, because of air resistance and the force of gravity, the trajectory of the projectile is actually a curve. The angle of fall is greater than the angle of ascension, therefore, the projectile reaches its maximum ordinate (highest point) closer to the point of impact than to the gun (figure 1). The tangent to the trajectory at the point of impact is

called the line of impact. The acute angle between the line of impact and the ground at the point of impact is called the angle of impact. The acute angle between the tangent to the trajectory at any point and the horizontal is called the angle of fall. The angle of fall and the angle of impact of a projectile will normally differ.

If a weapon were perfect, all rounds fired with the same initial data would strike the same point on the ground, if wind velocity and direction were constant. However, factors such as difference in weight and composition of propellants, difference in weight of projectiles, and varying atmospheric conditions, cause dispersion of the points of impact of projectiles fired under otherwise identical conditions. For this reason a number of projectiles fired at the same elevation and deflection will form a pattern in the impact area. This pattern is roughly elliptical in shape with its longer axis along the line of fire (figure 2). In other words, the rounds will be scattered more in range than in deflection with the density of the shots being greater at the center of the pattern than toward the edges.

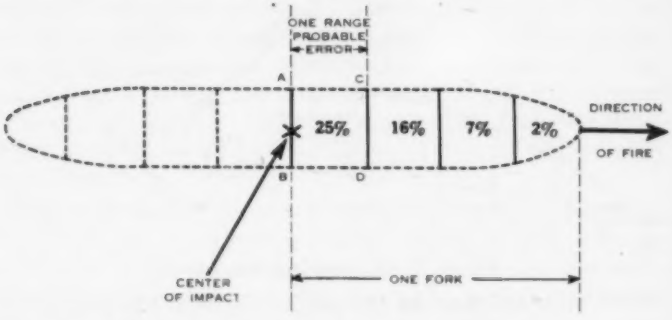


Figure 2.—Dispersion pattern.

It has been found through experiment that if enough rounds are fired at the same elevation and deflection, half will fall beyond the center of impact and half will fall short of it. In figure 2, the line AB has been drawn through the center of impact perpendicular to the line of site. The line CD has been constructed parallel to AB so that the number

of shots between AB and CD is the same as the number remaining in the right half of the dispersion pattern. The area ABCD will therefore contain 25 percent of the shots. The length (direction of fire) of the 25 percent zone represents one *range probable error* because this error is exceeded as frequently as it is not exceeded. If lines are drawn parallel to AB at a distance of one range probable error from the center of impact, the small areas thus created will contain percentages of total shots fired approximately as shown in figure 2. Eight probable errors (four on either side of the center of impact) will cover the dispersion pattern. The value in yards of a range probable error, which value varies directly with the range (gun to center of impact), can be determined by consulting a firing table.

RANGE DETERMINATION

Proficiency in determining range accurately is the principal factor which determines the ability of a trained gunner to obtain a target hit with the first round. It is probable that the length of time a gun will be able to continue firing from a direct fire position will be very limited. In addition, ammunition supplies at the gun position will normally be very limited. It is therefore of vital importance that range determination be rapid and accurate.

The quickest method of determining ranges is estimation by eye. In many cases it will be the only possible means whereby ranges can be determined. The ability to determine ranges by this method with acceptable accuracy depends on the training and experience of the individual. Accuracy can be attained through practice exercises which require the individual to observe from various angles and from various ranges, a measured 100-yard marked distance. After the soldier has attained a mental picture of 100 yards at these angles and ranges he is required to estimate an unknown distance. He does this by applying successively his 100-yard mental "yardstick" to the range to be estimated. For ranges over 500 yards, the observer picks out a point which is halfway, estimates the distance to the halfway point, and multiplies the answer by two.

Ranges may also be determined by adjusting the fire of the weapon on the target or on a point near the target. However, the possibility of prematurely disclosing the gun position makes employment of this method undesirable in many cases.

Ranges may also be determined from maps or photographs, or from personnel of units being relieved from the area.

SPEED AND LEAD DETERMINATION

In firing against moving targets, the ability to determine the speed of the target and to compute the proper lead is a requisite for rapid adjustment. These skills are closely allied since the observer or the gunner can not arrive at the correct lead estimation without first having correctly estimated the speed of the target.

The only satisfactory method of teaching speed estimation is to train the individual to estimate the speed of actual targets, moving at varying speeds, ranges, and angles with respect to the observer.

After arriving at an estimate of the speed of the target, it is a comparatively simple matter for the gunner to compute the proper lead. The number of leads employed varies with the speed and direction of movement of the target, but, since the lead markings on the sight represent angular leads, no consideration need be given to range. The ballistic qualities of the various projectiles for these weapons are such that three angular leads (15 mils) are allowed for each 10 mph of target speed when the path of the target is at an angle of 45° or greater to the line of fire. When the path of the target is at an angle of less than 45° to the line of fire, half this number of leads are used. For targets traveling directly toward or away from the gun, no leads are necessary.

FIRE CONTROL

Fire control is a composite term which embraces all operations connected with the preparation and actual application of effective fire upon a target. Specifically, it

includes the ability of the leader to open fire at the instant he desires, adjust the fire of his gun or guns upon the target, shift fire from one target to another, regulate its rate, and cease firing at will. Lack of proper fire control results in loss of surprise effect, premature disclosure of position, delivery of fire on unimportant targets, loss of time in making adjustments, and waste of ammunition.

Successful fire control is based on discipline and technical training of units and individuals. The discipline imposed, however, is sufficiently flexible to allow for decentralization of control when widely separated gun positions are occupied. Further, such control measures are based on simple, easily understood methods because noise, limited vision, and fleeting opportunity will frequently prohibit issuance of anything but brief commands.

Technical training of units and individuals is directed toward rapid and accurate delivery of the first round, followed by rapid adjustment with a minimum number of rounds in the briefest possible time. To attain this end, leaders, gunners, and assistant gunners must thoroughly understand the method of adjustment employed when the target is less than 1,000 yards distant, the method utilized when the target is at a range greater than 1,000 yards, and the procedure employed when firing over the heads of friendly troops.

In adjusting fire at ranges of 1,000 yards or less, direct readings for deflection and estimated range corrections necessary to bring the burst to the target should be employed. Where possible the gunner, under the supervision of the squad or section leader, makes his own corrections and applies them to the weapon without command. The squad or section leader issues subsequent commands when, in his judgment, speed or effectiveness of fire can be enhanced by so doing.

For ranges in excess of 1,000 yards the squad or section leader issues subsequent fire commands using the bracketing method of adjustment for range and direct readings from his binoculars for deflection. In the adjustment of fire by the bracketing method, the observer senses the first

rounds (either *over* or *short*) and estimates the distance in range from the burst to the target. He then makes a sufficient elevation (range) correction to insure that the next round lands definitely over (if the burst was short) or short (if the burst was over). Each subsequent round is fired at the mean of the last over and short. The process of reducing the size of the bracket is repeated until the distance between bursts is not greater than 25 yards or a target hit is obtained. The initial range change is never less than 200 yards unless knowledge of the terrain or other factors make it apparent to the gunner or squad leader that application of the adjustment procedure for targets less than 1,000 yards in range will result in more rapid adjustment.

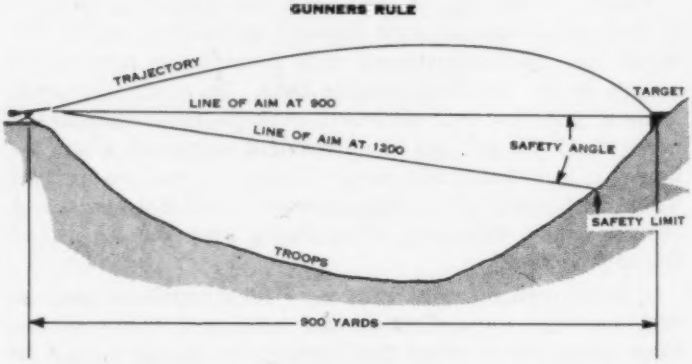


Figure 3.—Application of the gunner's rule when range from the gun to the target is 900 yards.

Special care is required in firing over the heads of friendly troops. Both the 57-mm and 75-mm rifles are capable of delivering this type of fire provided that they are in a stable, stationary position. Such fire must pass a safe, carefully determined distance above the friendly troops; that is, the minimum clearance or safety angle must be accurately established.

The minimum clearance for ranges up to 1,000 yards is determined by applying the gunner's rule. Although the

procedure will insure ample troop clearance, it will not insure that troops will be far enough from the impact to avoid all shell fragments. In using the gunner's rule, lay the gun on the target with the correct sight setting to hit the target. Without disturbing the lay of the piece, sight down the reticle scale to the 1,200 yard graduation and fix the point where the line of sight strikes the ground. If friendly troops are beyond this point it is unsafe to fire. Overhead fire can be delivered until friendly troops reach this point. (See figure 3.)

When it is necessary to determine mask and troop clearance for ranges in excess of 1,000 yards or when a more accurate value than that obtained by the gunner's rule is required, employ the method outlined in FM 6-40.

FIRE COMMANDS

Fire commands are the technical instructions issued to enable a weapon's crew to engage a desired target. There are two types of fire commands: initial fire commands, issued to get the first round on the way; and subsequent fire commands, issued to adjust or shift fire and to cease or suspend firing.

A correct fire command is as brief as clarity permits, includes all elements necessary for accomplishment of the fire mission, is given in proper sequence, and is transmitted clearly at a rate which permits receipt and execution without confusion.

In all fire commands numbers are announced as illustrated in the following examples:

10	ONE ZERO
25	TWO FIVE
300	THREE HUNDRED
875	EIGHT SEVEN FIVE
1400	ONE FOUR HUNDRED
1925	ONE NINE TWO FIVE
3000	THREE THOUSAND
4050	FOUR ZERO FIVE ZERO
100.7	ONE ZERO ZERO POINT SEVEN
254.4	TWO FIVE FOUR POINT FOUR

The phonetic alphabet is used whenever necessary to insure complete understanding, and all commands are repeated by the gunner except when firing at moving targets.

The following sequence for the initial fire command is prescribed in order to accustom the crew to execute instructions in a definite routine and in order to transmit these instructions in the sequence in which they will be executed.

The alert	FIRE MISSION
Type of ammunition	WP
Fuze (75-mm HE only)	DELAY
Direction	RIGHT FRONT
Target description	ENEMY PILLBOX
Range	700
Leads	(omitted if not applicable)
Command to open fire	FIRE

Any unnecessary elements are omitted from the fire command. Elements which are unchanged are omitted from subsequent fire commands.

The alert is always the first element of the initial fire command. Its purpose is to designate the crew or individual who will fire and to bring them to a state of readiness to receive the command. The alert consists of the designation of the crew or individual to fire and the target alert. The target alert is FIRE MISSION, for stationary targets, and MOVING TARGET, for moving targets.

Ammunition is designated as follows:

High explosive	HE
High explosive, antitank	HEAT
Smoke	SMOKE or WP
Target practice	TP

In firing high explosive ammunition with the 75-mm rifle, DELAY is used to indicate that a fuze setting of delay is desired. It is not necessary to give QUICK unless a fuze setting of delay has been used and it is desired to change to a quick setting.

Direction is given by any of the following methods:

General direction and clock system. FRONT is understood as the direction in which the muzzle points. Directions varying therefrom by successive angles of 45° are designated as RIGHT (LEFT) FRONT: RIGHT (LEFT) FLANK: RIGHT (LEFT) REAR. In the clock system, the gun position is assumed to be the center of a horizontal clock with the gun muzzle pointing to 12 o'clock. This allows more specific designation of the direction (see figure 4).

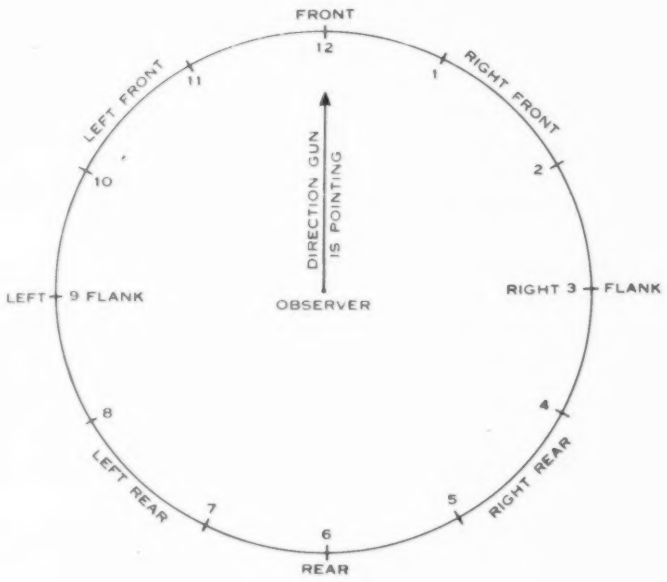


Figure 4.—Diagram showing the clock system of indicating direction.

Reference point and mils. Whenever time permits, in occupying a position a reference point is designated in the center of the sector of fire. The gunner then lays on the reference point at a zero setting and, by using the sight reticle of the telescopic sight, he can measure horizontal angles of thirty mils or less. Example: REFERENCE POINT, RIGHT TWO FIVE.

Reference point and distance. This method should be used at very short ranges only. Example: REFERENCE POINT, LEFT ONE HUNDRED YARDS.

Successive reference points. A clearly defined reference point is first designated. The gunner is led step by step to the target by naming successive reference points until his line of aim is brought to the target. For example: REFERENCE: RED ROOFED HOUSE: TO RIGHT OF HOUSE, A HEDGE: CENTER OF HEDGE, GATE: JUST ABOVE GATE, TARGET: MACHINE GUN IN EDGE OF FIELD. (Note that the word TARGET precedes the target description.)

Firing the gun or M1 rifle. Designating an indistinct target by firing a tracer round from an M1 rifle is a simple, rapid, and accurate method but may disclose the gun position. The person designating the target orally gives the general direction of fire as RIGHT FRONT, then commands WATCH MY BURST (TRACER).

Laying the gun. The person designating the target may actually lay the gun himself to point out the target location.

A brief description of the target, usually a word or two, is all that is required, but it must create a definite picture in the gunner's mind. If several targets are in view, or if two or more guns are engaging a wide or deep target, the particular target or part on which fire must be placed is designated as: LEADING TANK: RIGHT BUILDING: FAR END: HALTED COLUMN: etc.

The initial range is announced in yards. Since this element always follows the target description, and since the yard is the standard unit of range measurement, neither the word "range" nor the word "yards" is included in this announcement.

The lead element is included in the initial fire command only when firing at moving targets. One lead is an angular measurement of 5 mils.

The fire control element is the command to commence firing. It is FIRE. Strictly interpreted, this is an order for the gunner to open fire when ready. If the leader desires to open fire at a specific time, he must give AT MY

COMMAND or AT MY SIGNAL. He may also designate the exact number of rounds to be fired, for example, THREE ROUNDS, FIRE.

The following examples illustrate the use of fire commands.

Stationary target:

Alert	FIRE MISSION
Ammunition	HE
Direction	RIGHT FRONT
Target description	MACHINE GUN
Range	NINE HUNDRED
Command to open fire	FIRE

Moving target:

Alert	MOVING TARGET
Ammunition	HEAT
Direction	LEFT FRONT
Target description	TRUCK
Range	SEVEN HUNDRED
Leads	THREE LEADS
Command to open fire	FIRE

The elements of a subsequent fire command include a correction in deflection, a correction in range, a correction in leads, and the command to fire.

Subsequent fire commands are announced as corrections to the sight picture at which the last round was fired.

The following terms are used to announce the corrections:

Fire at the same range	REPEAT RANGE
Increase range	ADD (Number of yards)
Decrease range	DROP (Number of yards)
Move the burst or strike to the right (left)	RIGHT (LEFT) (Number of mils)
Increase leads	(Number) MORE
Decrease leads	(Number) LESS

When firing against stationary targets, corrections in deflection are given in mils as RIGHT FIVE; LEFT TWO; etc. If the deflection is correct, this element is eliminated from subsequent fire commands.

When firing at moving targets, the correction in leads is given as TWO MORE; ONE LESS; etc. This element is included in the subsequent fire command only when necessary.

The range element is always included in the subsequent fire command. If a correction is needed, it is announced as ADD FIVE HUNDRED; DROP TWO HUNDRED; etc. If the range is correct, this element is included as REPEAT RANGE.

If the leader or gunner fails to understand any element of the fire command, he requests a repetition of that element by announcing the misunderstood element using a rising inflection to denote a question. When any crew member asks that the deflection or range element be repeated, misunderstanding is avoided by prefacing the repeated element with the phrase THE COMMAND WAS..... This phrase is used only when repeating an element of an unexecuted fire command.

In all fire commands, an incorrect command is corrected by saying CORRECTION, and giving the correct command. To change an erroneous range command of 500 yards to a correct command of 600 yards, the command is: CORRECTION SIX HUNDRED, FIRE. (Note that the corrected command is followed by the command to fire.)

CEASE FIRING indicates a temporary interruption of firing. It permits resumption of fire with the same data on receipt of the command RESUME FIRING.

So that the crew may relax between fire missions, and so that their response to subsequent alerts will be more complete, the termination of the alert is announced as CEASE FIRING, END OF MISSION.

SUMMARY

The technique of direct fire with the 75-mm and 57-mm rifles entails few new training problems. As in other weapons, the primary objective is to fire the initial round with the maximum accuracy in the minimum time. To accomplish this end, leaders, gunners, and assistant gunners must be schooled in estimation of range by eye, estimation of speed

of a moving target, employment of bracketing procedure, and transmission and execution of fire commands. The time required to engage and destroy a target depends on the degree of proficiency attained in these subjects by the leaders and crew members of the 57-mm rifle section and the 75-mm rifle platoon.

Considerations Governing Operations in Snow and Extreme Cold

No area on the surface of the earth has evoked more current interest and speculation regarding its strategic importance in a future global war than the North Polar region. Until recently, physical difficulties have limited exploration and development of the Arctic. Today, however, it has become practicable to fly aircraft over the North Pole—this fact alone forces recognition of the Arctic as a new pivotal area of world activity. A glance at a polar projection map of the northern hemisphere shows immediately how direct airline routes across the Arctic bring the great land masses of the northern half of the world closely together. The continent of North America is bounded on the north, and is almost outflanked by, northern Asia and Europe.

The distance from Moscow to New York (4,665 miles) and from Tokyo to Seattle (4,285 miles) is within range of today's long-range aircraft. Alaska, Canada, and Greenland, lying squarely across these routes, have become the northern frontiers of our continental defense system. General of the Army H. H. Arnold stated it thus: "If there is a third world war, its strategic center will be the North Pole."

Military forces of the United States have had little experience which is of help in planning to meet the problems of cold-climate warfare. This is a new and active field of research. Concepts governing strategy and tactics, as presently developed, are subject to change as further information becomes available.

HISTORICAL BACKGROUND

Reference to notable winter campaigns in wars that are now history establishes certain precedents worthy of consideration. The hardships suffered by General Washington's

Figure 1.—The North Polar region.

troops at Valley Forge in the winter of 1777-78 are familiar to Americans. Severe cold nearly destroyed his small army, despite the fact that *it was not actively engaged in combat* with the enemy. Napoleon's retreat from Moscow in 1812

is another example of the destruction of an army by severe conditions of climate and terrain.

Reliable historians have concluded that lack of discipline among the French troops, which caused the withdrawal to turn into panic, is the primary cause of the disaster that befell Napoleon in Russia. However, the reverses at Moscow were brought about by attrition in the ranks, caused by exposure and hardship, and Napoleon was forced to retreat rather than face the dreaded Russian winter which was nearly at hand.

In the autumn of 1939, Russia attacked Finland with a force vastly superior in numbers but lacking the mobility of the hardy Finnish Army under conditions of deep snow and extreme cold. Invading Russian columns were harassed, outmaneuvered, and even cut off from their base during the early months of the war when small detachments of Finnish ski troops crossed into Russian territory and cut the Leningrad-Murmansk railroad. Russian troops suffered heavy casualties from severe winter weather, which included temperatures of -58°F in January 1940. During World War II, German troops met with the similar experiences and hardships during the winters on the Eastern front. Records of American cold-climate operations, in the Aleutians in 1942-43, and in the Ardennes and Vosges in the winter of 1944-45, show the pronounced effect of severe cold on the fighting ability of troops.

It may be concluded that the essential preliminary step to operations in snow and extreme cold is solution of the special problems of human survival and movement under such conditions.

CONTEMPORARY RESEARCH

The United States Armed Forces currently show a new interest in the Arctic, and to a lesser extent in the Antarctic. The Air Force is engaged in extensive reconnaissance, mapping, and meteorological survey flights in the North Polar region. The Navy, in Operation *Frostbite*, sent a task force into the Arctic Ocean in 1947, for a series of exercises

and tests. The Army is engaged in a number of activities related to cold-climate operations.

Trends in future development of materiel for the U.S. Army may be inferred from a recent statement by Lieutenant General Henry S. Aurand, Director, Service, Supply and Procurement Division, Department of the Army General Staff, in an address before a group of reserve officers in New York City, December 1947. Outlining the current objectives of U.S. military research on equipment, he placed two criteria at the head of the list:

Transportability. All equipment and weapons should be capable of transportation by air.

Effective operation under extremes of climate and terrain. Future weapons and equipment should be capable of operating with minor changes in wet or dry climates over a temperature range of 120° to -65° Fahrenheit, and a storage range of 160° to -80° Fahrenheit.

During the winter 1945-46, American observers participated in cold-climate operations conducted by the Canadian army, including Exercises *Eskimo, Lemming, and Polar Bear* in central and western Canada, and Exercise *Musk-Ox,* in which 48 men moved 3,100 miles by snowmobile between 16 February and 6 May 1946, from Churchill on Hudson Bay into the Arctic barren lands to Victoria Island, then across northwest Canada to the Alcan highway, and finally to Edmonton, Alberta.

The Army Ground Forces winter test program was placed in operation during the winter 1946-47, by the establishment of three task forces with the mission of conducting technical tests of materiel. Task Force *Frost* operated at Camp McCoy, Wisconsin; Task Force *Williwaw* on Adak in the Aleutians; and Task Force *Frigid* at Fairbanks, Alaska. During the winter 1947-48, the program progressed into the first extensive tactical training. In Exercise *Snowdrop,* at Pine Camp, New York, troops of the 82d Airborne Division were trained in airborne tactics and airhead operations under deep snow conditions. In Exercise *Yukon,* at Big Delta, near Fairbanks, Alaska, troops of the

2d Infantry Division were trained in air transportability and in small-unit tactics under extreme cold conditions.

CLIMATIC CONSIDERATIONS

Some explanation of terms is necessary. The Arctic Circle, latitude 66° 33′ N, is no longer considered the boundary of the *Arctic region.* Today, the region which has a truly Arctic climate is defined by an isothermal line which lies both inside and outside the Circle. It delineates the region in which the mean temperature during the warmest month of the year (July) is 50°F or less. Generally speaking, the timber line follows this temperature line; in other words, the Arctic climate is too cold, even in the warmest month of the year, to sustain the growth of trees and shrubs. The land areas are barren wastes; most of the region is frozen ocean, although the ice cap recedes in summer permitting navigation along the north coasts of Alaska, Canada, and Siberia. Only mosses and lichens grow on the treeless plains, which are called tundras. However, the region is sparsely inhabited by Eskimos, and a variety of animal life is found.

Surrounding the Arctic is a belt of variable width called the *Subarctic region,* because it has a more severe winter climate than the adjacent temperate zone. It includes most of Alaska, Canada, Siberia, and the Scandinavian countries. The Subarctic climate is broadly divided into two types: maritime and continental. The maritime Subarctic includes the islands and coastal regions, where ocean currents have a pronounced effect. The continental Subarctic includes the inland areas, which have seasonal climatic variations as great as any regions on the face of the earth. Winters are colder than in the Arctic itself; summers are particularly warm. At Verkhoyansk, in central Siberia on the Arctic Circle, a record low temperature of -90°F was recorded in February, 1892, yet it has an average July temperature of 60°F and once recorded a high of 93° in July. In January, 1947, the town of Snag, Canada, near the Alaskan border, experienced a record for North America of -82.3°F. Fort Yukon, Alaska, has recorded 100°F.

In general, the Subarctic is covered with heavy forests of both coniferous and deciduous growth. Trees are small with very short roots, and are easily uprooted. There are tens of thousands of lakes, the result of poor drainage induced by the presence of permanently frozen subsoil called "perma-frost." Some of the largest rivers in the world lie in the North—the Yukon in Alaska, the MacKenzie in Canada, and the Ob, Lena, and Yenesei in Siberia.

The other great region of extreme cold is the *Antarctic Continent.* Since it is a land area with a mean elevation of 6,000 feet, it is much colder than the Arctic, and is uninhabited except by bird life. There is no "Sub-Antarctic" region, because the continent is surrounded by oceans which have a temperate climate.

Types of Climate. For the purposes of military study, cold climates can be further classified as wet cold, dry cold, heavy winter, and summer thaw.

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The Arctic and much of the continental Subarctic have dry cold. There is little or no precipitation, because most of the moisture is condensed from the air as it passes over the outer fringes of the cold region. However, snow and ice remain indefinitely, because temperatures are below freezing almost continually throughout the six to nine month winter period. The air is very dry and clear most of the time.

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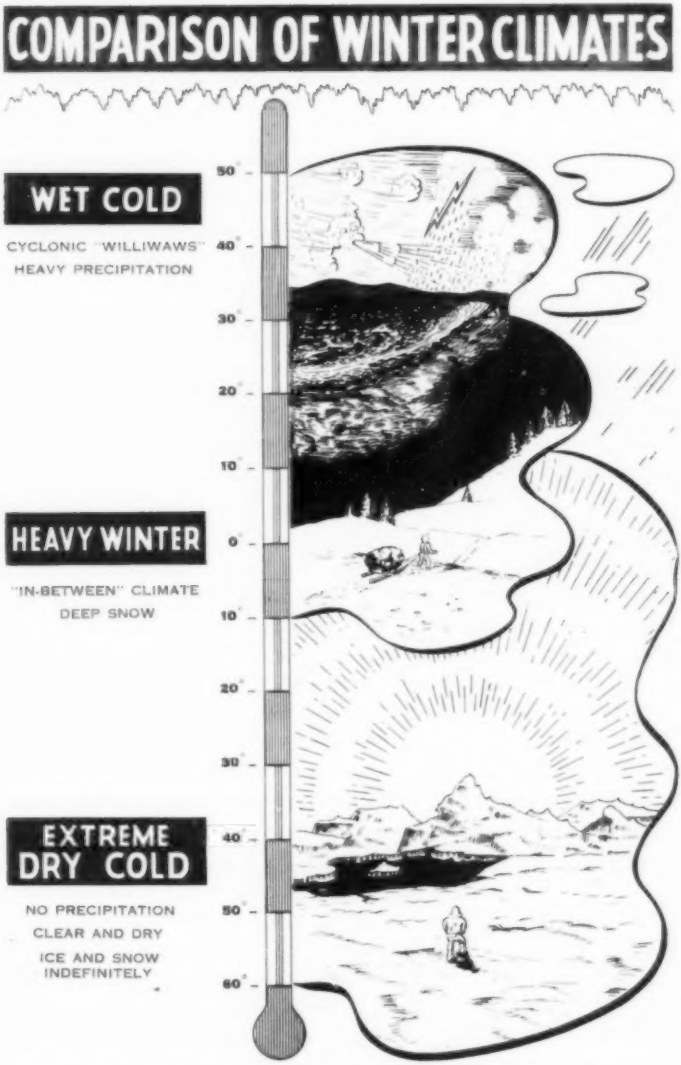

Figure 2.—Range of Farenheit temperatures in winter climates.

Since wet cold and dry cold climates differ radically, it is obvious that areas will be found which have an "in between" climate, where precipitation is heavy, yet the temperature is low enough to prevent thawing for a few months of the year. These are the areas of heavy winter, such as northern Wisconsin and Michigan, Vermont, and southern Germany. They are characterized chiefly by deep snow.

Summer conditions in the Subarctic are such that travel across country is nearly impossible, except by canoe or float plane. Warm, even hot, weather brings a prolonged surface thaw. Streams are swollen, lakes overflow, surface water stands everywhere on flat terrain, and top-soil turns into bog above the forest level. Insects of all kinds are prevalent; mosquitos, especially, are a serious menace.

It may be concluded, then, that planning for operations in the Far North requires provision for warmth and shelter of troops against low temperatures and high winds, and for means of movement across deep snow, soft mud, thick forests, and water barriers.

Related physical factors. Climate is naturally the most important consideration affecting operations in the Far North. Certain other physical factors have an important relation to the climate conditions.

The unusual seasonal variation of day and night is important. In midsummer along the Arctic Circle, there is about 20 hours of daylight, with about twice the amount of insolation (rate of delivery of solar radiation, warming the earth's atmosphere) received in the tropics. In mid-winter there is less than four hours of daylight at Nome, with the sun barely visible above the southern horizon; at Point Barrow there is no daylight at all during December and January. The sun no longer warms the air; the temperature sinks lower and lower.

The moon has an important effect on the Arctic winter night. With the clear, cold air and the snow-covered terrain, moonlight is especially brilliant. There is also the aurora borealis, or "northern lights," a natural phenomenon that often brilliantly illuminates the night sky. The Arctic winter night is not nearly so dark as one might think.

Another natural phenomenon found in the north is mirage. As in the desert, mirage is caused by the reflection of light through layers of air of varying temperatures. Normally, the temperature decreases uniformly as the altitude increases. In extreme cold areas, lighter, warmer air layers may lie on top of dense, very cold air, creating a temparature inversion as great as 40° at 1,500 feet altitude.Under certain conditions, particularly at sea, an effect known as "looming" may occur, in which ships, icebergs, or other objects beyond the horizon appear upside down and greatly magnified on the lower surface of a cloud.

"Ice fog" is another phenomenon of military importance. Under low temperature conditions, beginning about -20° and especially at -40° and below, the air has practically no ability to retain moisture. Any moisture discharged into the air immediately forms into a suspended cloud of fine ice crystals. It forms vapor trails behind aircraft, dense clouds around buildings, air strips, groups of vehicles when engines are running, and in front of muzzles of weapons as they are fired.

Certain magnetic conditions must also be mentioned. Magnetic north is not at true north, since the north magnetic pole is located in the islands of northern Canada. (The Air Force has announced the discovery of three different magnetic poles—on Boothia Penninsula, and on Bathurst and the Prince of Wales Islands. In fact, the magnetic pole is not a fixed point at all, but rather a vertical magnetic field.) This results in difficulties in compass navigation near the magnetic pole, and in abnormally great compass declination anywhere in the North, with considerable variations during even a short movement. Magnetic declination at Fairbanks, for example, is approximately 35° east.

TERRAIN EVALUATION

Observation. The foregoing analysis of climatic and terrain conditions permits certain conclusions to be drawn regarding visibility. In wet cold areas, observation generally is poor because of rain, fogs, and snow. Also, throughout

immense forested areas, visibility is restricted by thick growths of timber and underbrush.

In dry cold areas, observation generally is excellent, both by day and by night. Of course, visibility is reduced at times by drifting snow, by glaring sunlight, or by ice fog. Usually, however, it is possible to see fires, vapor, dark or colored objects, and movement of any kind, even at great distances in the clear, cold air. Tracks in the snow are plainly visible, especially to aerial observers. Sounds are plainly heard at long range. Depth perception is somewhat affected; objects seem closer than they really are, and it is hard for the eye to detect depressions and elevations in snow-covered terrain.

Fields of fire. All the normal factors are present in consideration of fields of fire, plus the special effect of winter climate. Deep snow, soft mud, or extreme cold each tend to reduce the effect of fire. High explosive shells or grenades have a small radius of burst when fired into soft snow or mud, requiring employment of air-burst ammunition to obtain proper fragmentation effect. About sixteen feet of soft snow will stop a machine gun bullet; guns laid for grazing fire over the surface of the snow are ineffective against personnel taking cover in the snow. Fire lanes must be cleared and the snow packed down when automatic weapons are laid for defensive fire.

Cover and concealment. Cover from hostile fire, in addition to the normal use of defilade, may be obtained by taking advantage of deep snow. When the ground is frozen, construction of foxholes or dug-in emplacements is impracticable. However, parapets of packed snow six to nine feet thick will stop small arms fire, and when soaked with water and allowed to freeze, they have the strength of parapets constructed of logs or packed earth. Concealment may be good in the hilly, forested parts of the region, but difficult to find on the open tundras. Special training in winter camouflage is needed to develop the ability to effectively conceal installations in snow-covered areas. Solid white clothing and camouflage paint, while they may provide concealment against a pure white snow background,

bring personnel and objects into sharp relief against dark backgrounds such as woods and brushy terrain. The principle of breaking the outline or shape still is of primary importance. Movement is best concealed by darkness.

Obstacles. Next to extreme cold itself, obstacles to movement include deep snow in dry-cold areas, mud in wet-cold areas or during seasons of thaw, and broken ground or dense forests. Presence of firmly packed snow actually increases the mobility of troops trained in the use of skis. Over frozen ground, the mobility of vehicles of proper design may be high. On the Arctic tundras, vehicles may move with a freedom similar to that afforded by desert terrain. Frozen lakes or rivers, instead of being obstacles, actually become routes of movement. The Canadians on Exercise *Musk-Ox* rolled their snowmobiles for 200 miles across the ice of Great Bear Lake. During the last war, the Russians laid a railroad across the ice of Lake Ladoga to reach Leningrad when the Germans had nearly cut off the city. Cross-country operations in hilly country or in areas covered by forests and deep snow require extensive use of engineer equipment.

Lines of communication. Roads and railroads are practically nonexistant in the Far North, and towns are few and far apart. This creates the problem of long supply lines, difficult to open up and maintain. The luxury of multiple routes is almost out of the question. Existing seaports and air bases require development before their capacity is sufficient to support military operations. Use of the more northern ports is restricted or impossible in mid-winter. Construction of over-land supply routes is simplified when the ground is frozen; a frozen surface will support military traffic without the need for the customary grading and surfacing.

HUMAN SURVIVAL

Difficulties involved in the employment of troops in winter operations in the Far North do not stem directly from a concept that extreme climate is beyond the limit of human endurance. Temperatures as cold or colder than

the Subarctic frequently are experienced in the United States in the area between the Great Lakes and the Rocky Mountains. Rather, the chief obstacle is the lack of civilized development of the Subarctic—a handicap that may be considered temporary in nature, since the northern frontier is steadily being advanced. The problem becomes simply one of providing troops with proper training and equipment, in order that they will respect—instead of fear—the extreme climate, and will be capable of performing a combat mission under adverse climatic conditions.

Individual clothing. Warm clothing is an absolute necessity. It is the primary requirement. Present research is directed toward development of clothing that is warm at the lowest temperature, but which is not too bulky or heavy, and which can easily be adjusted to variations in the temperature or to variations in the degree of activity of the wearer. Ventilation, to permit body moisture to escape, is as important a requirement as insulation. These requirements will undoubtedly be met to a satisfactory degree. It is apparent, however, that a hand covering heavy enough to keep the hands from freezing at -50° will permit only limited use of the fingers. A man must be able to fire a weapon, adjust skis or snowshoes, open a pack, and perform other simple operations without removing his mittens. Although a man may expose his hands to extreme cold for a few minutes, he will freeze them instantly if he touches directly a wooden or metal object. Therefore, it is obvious that in extreme cold weather tasks requiring extensive use of the fingers must be performed inside a shelter. Such a conclusion has profound tactical significance.

Shelter. Efficient operation of large base installations requires permanent-type buildings. Under development are various types of portable prefabricated shelters, suitable for quick erection and use in advanced bases. Snow houses give adequate shelter against the cold, and troops can readily learn how to build the Eskimo-type igloo. However, much time and labor is involved in their construction, and they do not replace the need for a suitable tent for use as temporary shelter. Since tentage imposes problems of

transport and erection, extensive use may be made of small shelters mounted on sleds (Wannigans) which can be towed to the desired location. In extreme cold, vehicles become not only a mode of transportation but also a means of shelter. Vitally needed shelter is constantly menaced by the hazard of fire under conditions of severe cold or high wind, when stoves and heaters are run full blast. Materials become highly inflammable in the dry air. The added danger is that freezing water will make fire-fighting equipment inoperative. Destruction of shelter through enemy action can have disastrous consequences.

Figure 3.—Failure of tentage in high wind on the Aleutian Islands.

Food. Personnel living in extreme cold must have additional nourishment to build energy in the body. Despite the rapid heat loss when the air temperature is 150° or so lower than body temperature, the body must maintain its normal temperature. The ration should provide from 4,500 to 5,500 calories per man per day, which is about 50 per cent more than normal. Hot food and hot stimulants are absolutely necessary for men who are cold and tired. Meals prepared in kitchens must be served inside mess shelters; otherwise, the food becomes cold before it can

be eaten. Emergency rations and coffee or tea heated and distributed in insulated containers, will still be warm and palatable even after ten or twelve hours exposure to 50-below cold.

Water. Although water may be readily obtained by cutting a hole through the ice of a lake or stream, water supply is complicated by the problem of keeping it from freezing before it is consumed. Melted snow is a source of water, but this takes a prohibitive amount of heating un-

Figure 4.—The Jamesway hut is a portable prefabricated Arctic shelter.

less troops understand the proper technique of melting it. Water tanks may be placed inside heated shelters for storage and for transport when the tank-shelters are mounted on sleds. Individual canteens should not be more than three-fourths filled to prevent bursting if the contents freeze. Canteens of the thermos type are valuable for carrying water or hot stimulants.

Sanitation. Special measures are required to maintain the health of troops during cold weather. Because it is cold

and men are reluctant to remove their clothing, personal cleanliness becomes a problem. Suitable heated latrine shelters and bathing facilities must be available. Disposal of body wastes is a difficult problem.

Medical problems vary with the degree and type of cold. In wet cold areas, trenchfoot develops easily. It is prevented by keeping the footgear dry and by maintaining good blood circulation in the feet. In colder weather, frostbite is the common effect of exposure. Frostbite is prevented by adequate dry clothing and by alertness—men must watch themselves and each other for signs that indicate blood circulation has stopped and freezing is about to occur. Overexertion or too much clothing causes perspiration. Damp clothing sticks to the skin, eliminates the dead air spaces, and conducts the heat rapidly from the body. Men must try to avoid perspiring, or to seek shelter immediately if their clothing becomes damp. On sunny or hazy days, precautions must be taken against snowblindness.

Of course, a man can freeze to death in extreme cold, but this possibility is offset by the strong instinct for self-preservation. A more dangerous threat is carbon monoxide poisoning, which kills painlessly, without warning. Because this gas is the product of the incomplete combustion of carbon (gasoline, fuel oil, coal), all heated shelters and vehicles must have fresh air ventilation to prevent accumulation of a lethal concentration.

Care of the wounded in cold climates is complicated by the fact that warmth is an important requirement in first aid. To prevent the dangerous condition of shock, wounded men must be evacuated promptly to a warm place, and must be protected from the cold during evacuation. Task Force *Frigid* experimented with the "buddy system" and found it good. All men were paired off, and buddies remained within sight of each other. They assisted each other in preventing frostbite, and if one became exhausted or injured, his buddy would see that he received immediate assistance. A buddy system could be employed in combat.

Acclimatization and training. Vilhjalmur Stefansson, Canadian Arctic explorer, has stated, "If required, a man

may learn to *endure* the tropics, but it is absolutely essential that he learn to *protect* himself in the Arctic." Special training in the use of Arctic clothing, skis, snowshoes, shelters, and the other considerations of survival discussed above, must be given troops prior to exposing them to actual conditions of extreme cold. Mental conditioning is necessary to allay fears born of ignorance and give troops confidence in their ability to operate successfully in the severe climate. Acclimatization is the process of allowing the body to adjust itself to the need for increased heat production. These adjustments are internal; the skin does not become hardened to cold. Increased appetite for foods high in caloric content (fats and carbohydrates) is an example of internal adjustment to climatic conditions. The Canadian Army has recommended a period of ten weeks for preliminary training and acclimatization of troops.

EQUIPMENT

Briefly, equipment for cold climate operations must possess two special characteristics: mobility under winter conditions, and capability of proper performance in extreme cold. Present vehicles, weapons, and communications equipment of the United States Army have been tested under cold climatic conditions, and the necessary modifications are being developed. Problems encountered must be understood by commanders to insure proper supervision of equipment maintenance under operating conditions.

Ordinary lubricants solidify at -35°F. Special Arctic lubricants remain fluid at -65°. Difficulty of starting engines in extreme cold requires vehicles to be equipped with standby heating systems. Only tracked vehicles have the desired mobility over snow, mud, and ice. Brittleness of metal, and differential contraction of various metals, may cause broken parts or malfunctioning. Improvement in design and construction of over-snow vehicles is a continuing project. Sleds and toboggans, towed by a prime mover, can be used to replace the wheeled trailers used in normal terrain.

Functioning of weapons, after minor modifications, is normal. In dry cold, only the lightest lubricants are used

to prevent sluggish action of moving parts—there is no problem of rust. In wet cold areas, corrosion is rapid, requiring frequent cleaning and lubrication. Functioning of communications equipment may also be considered normal.

An understanding and successful solution of the foregoing special problems of living, moving, and fighting in a cold climate is a prerequisite to the consideration of winter warfare tactics, which—it will be discovered—are basically no different from the tactics of operations in normal terrain and climate.

II

STRATEGIC CONSIDERATIONS

In Part One of this dicussion it was determined that it is entirely practicable to live in the Subarctic and Arctic regions, and that modern developments are hastening the civilization of the Far North. More than 500,000 Russians live and work north of the Arctic Circle. Important deposits of oil, coal, iron, and other minerals are known to exist there. Development of this wealth of natural resources, and of new direct routes of communication across the Polar region, favors growth in population and expansion of sea and air ports in the North. Collision of the expanding interests of world powers may result from the discovery of valuable oil and mineral deposits in Polar areas which are not, as yet, the recognized territory of any country.

In any future global war, the defender will be compelled to reinforce his northern outposts to protect his interests in the North itself, and to deny the enemy a convenient stepping-stone for operations against the heart of the defended country. Strategy of the aggressor undoubtedly will include the surprise seizure of bases in the Arctic and Subarctic to support his line of communications and to support operations against the defender's outposts and critical areas in the North. Primary requirements for such operations are seaports, air bases, and launching sites for guided missiles. Execution of strategy by both the defender and aggressor involves the employment of air power in its

widest application. A war for strategic bases as visualized here does not contemplate the establishment of a continuous front in Arctic wastelands. Rather, such a campaign would be similiar to the island campaigns in the Pacific during the last war.

LOGISTICAL CONSIDERATIONS

Support of large-scale operations in the Far North will require the combined use of air, water, and overland transport. Length and scarcity of lines of communication tend to limit the scale of operations. Supply of a field force in the Arctic by air from remote bases involves consideration of the tremendous number of aircraft required and the large proportion of payload that must be reserved for aircraft fuel during the round trip.

During the last war, American forces in active theaters of operations required approximately 70 pounds per man per day of all classes of supply. Tonnages comprising a day of supply for a force engaged in Polar operations are not yet firmly estimated. However, it is safe to assume that they will be considerably greater than normal, for all classes except possibly ammunition. Ration allowances, for example, must be increased 50 per cent. The additional weight and bulk of Arctic clothing is a major consideration. Much special equipment is needed by troops, and during operations, a high ratio of replacement equipment may be required—for example, salvage of equipment in the battle area ceases to be remunerative when every object left in the snow rapidly disappears from view. Lack of adequate local shelter requires the importation of shelter. Fuel consumption, both for vehicle operation and for heating of shelters, will be several times greater than normal.

As in operations in any sparsely settled area, there are no local sources of supply which can be tapped to lighten the burden on the supply line.

TACTICAL CONSIDERATIONS

Mass. In order to wage war successfully in cold climates, an army must, as always, be capable of concentrating combat power superior to that of the enemy at the decisive

point at the proper time. Combat power results from successful solution of the problems of *survival*, in addition to the normal strategic and tactical considerations. Concentration is possible only if the force has *mobility* despite the terrain and the cold.

Objective. The mission of the force employed in cold climate operations is to break the enemy's will to resist by destroying the hostile force. This implies the necessity for attack and destruction of the hostile bases. In extreme cold, it is easy to visualize the effect on the enemy, of operations which destroy his shelter, or deny his use of places affording shelter, and also of operations which impair his lines of communication, denying him vitally needed supplies. Resultant hardship and loss of mobility make him subject to defeat by two enemies: the opposing force, and the extreme climate.

Surprise. Tactical surprise is achieved through assumption of the initiative and by deceiving the enemy as to the method, direction, strength, and time of attack. Again it is necessary to be mobile, so that troops can be maneuvered into position to launch an attack from an unexpected direction or in unexpected strength. Airborne troops have demonstrated their ability to operate in deep snow and extreme cold; their capability of rapid concentration makes their employment an important weapon of surprise. Concealment of the movement of troops is facilitated by the long periods of darkness during the winter months, when frozen ground presents terrain conditions most favorable for operations. Because the enemy may have excellent observation in snow-covered terrain, he may be tricked by deliberate deception. Decoy movements and dummy positions will usually be noted by the hostile air and ground observers. At the same time, concealment of real positions and intentions is carefully preserved. Proper use of winter camouflage is an important means of concealment.

Security. Good long-range observation and restrictions on the enemy's ability to maneuver facilitate security. Air reconnaissance will, during periods of unfavorable weather, be ineffective, and may not disclose the location of hostile

movements or installations in areas where dense forests provide concealment. Distant ground reconnaissance may be performed by highly mobile forces employing light tracked vehicles or skis. Local patrolling and maintenance of observation posts or outposts involves the additional problem of providing shelter or reliefs to offset loss of efficiency at low temperatures. The heavy winter fighting in the Ardennes and Hurtgen Forest in the last war demonstrated a security problem arising out of the deadening effect of inertia. Men who are cold and exausted tend to become preoccupied with the problem of personal comfort. Morale and alertness decline. Leaders must exert the maximum effort to insure proper preformance of patrol and outpost missions during a sub-zero night.

Figure 5.—Helicopters equipped with pontons for landing in soft snow perform reconnaissance missions for vehicle columns.

Heavily frozen rivers and lakes cease to become barriers to the approach of mechanized forces. Mines may be laid on the ice, or preparations may be made to shatter the ice with explosive charges, bombs, or heavy artillery shells to make rivers and lakes impassable.

The smooth surfaces of frozen lakes should be regarded as possible drop zones for airborne troops, especially in forested areas. Such open areas can readily be covered by fire, and may be made unusable by placing mines on the ice and erecting poles in the ice.

Cooperation. Application of the principle of unity of command is essential to effective conduct of operations in any climate. It must be emphasized again that commanders must put forth their best efforts to insure coordination and teamwork when weather conditions adversely affect the efficiency of subordinates.

Offensive action. Severe cold and obstacles to movement under winter conditions favor the defender who remains close to the resources of his base while the attacking force is exposed to the elements. While at times assumption of the defensive may be necessary or attractive, no favorable decision can be gained without resort to offensive action. The offensive should not be undertaken without high morale

Figure 6.—Recovery of trailer carrying medium tank after it has broken through thin river ice, even though the temperature is -54° F.

and good physical condition of troops. The offensive action must be carefully planned, bearing in mind the condition of the command and the weather and terrain conditions to be encountered, to insure that offensive pressure can be maintained until the objective is taken, and that the attack does not fail through inadequate planning or failure to appreciate the difficulties to be overcome. The offensive plan must be sufficiently flexible to allow for adjustment to changes in weather as they occur. Once a plan of operations is decided upon, it is executed promptly and vigorously.

Movement. Ability to maneuver depends on the battlefield mobility of combat elements. Aside from the mobility of airborne units before they are committed, movement of troops in the area of operations involves, to a large extent, the use of track-laying oversnow vehicles. Vehicles not only provide a means of movement, but they are, in themselves, shelters which permit troops to operate at a greater distance from bases affording shelter. Also, the employment of vehicles affords, in part, the solution to the problem of performing detailed hand operations in extremely cold weather.

Figure 7.—Two cargo carriers, M29C (Weasels), towing a wannigan up a steep frozen incline.

In addition to the conventional use of supply and evacuation vehicles and armored fighting vehicles, a number of other activities which must take place on the battlefield despite the cold are performed in vehicles. Bridging the gap between the assault echelon and the fixed or semi-fixed shelters in rear areas are mobile command posts, fire direction centers, radio stations, aid stations, kitchens, battlefield maintenance units, and even latrines. Track-laying personnel carriers are employed to increase the mobility of dismounted units before commitment. Crew-served weapons and their ammunition are transported in oversnow carriers.

Regardless of improvements in design of vehicles to improve mobility over snow, mud, or other obstacles, it is fallacious to assume that all fighting can be done from combat vehicles. Dismounted infantry must be capable of maneuver when obstacles or hostile fire prevent the use of vehicles in the assault echelon. Infantry trained in the use of skis has increased mobility over firm snow. With favorable snow conditions, trained ski troops may march as much

Figure 8.—Ski troops attempting "ski-joring" behind an oversnow vehicle, in column formation because of powder snow and underbrush. Trained skiers, using wedge formation on firm snow, may be towed successfully at 30 miles per hour.

as 30 or 40 miles in one day. However, in extreme cold snow is soft and powdery, reducing the mobility of the skier to that of a man on foot—as low as half a mile per hour. Snowshoes are helpful in walking on deep soft snow. Infantry may be moved rapidly to positions within assaulting distance of the objective by riding in personnel carriers or on tanks, or by being towed on skis behind vehicles.

Careful selection of routes of movement may be necessary to preserve mobility. Successful envelopment of a hostile position is based on concentrating superior forces against a flank of the enemy. Therefore, the speed of the maneuver must be great enough so that the defender lacks time to shift his reserves to meet the envelopment before a decision can be won. When practicable, the advance is made along ridge lines where the wind has packed or swept clear the snow, and avoids valley bottoms and heavy forests. Movement of armor through thick woods is a slow process, imposing difficulties similar to movement in jungles. Even when the armored vehicles are capable of forcing their way through the deep snow and dense brush, their rate of march will be slowed to correspond to the rate of movement of the accompanying infantry.

In pursuit in snow, the most mobile troops of the pursuer, including ski troops and armor, are employed to encircle the hostile force, seizing critical terrain features dominating his route of withdrawal. Other ground troops exert direct pressure to prevent disengagement until the enemy can be destroyed. When envelopment by ground maneuver is impracticable because of slowness of movement, airborne troops are landed near defiles to block the hostile retreat.

Economy of force. Ability to concentrate superior forces at the point selected for attack requires the exercise of economy of force. In operations in the Far North, this principle implies holding bases, lines of communication, and critical positions with the minimum essential force, and retention of major strength in reserve forces capable of commitment to offensive or counteroffensive action. Proper locations for such reserve forces are determined by their mobility in relation to that of the hostile force, so that the time required for movement to a critical area permits arrival at the decisive point at the proper time.

Extreme cold, in itself an enemy, is a factor to be considered in applying the principle of economy of force during offensive operations. Troops committed to the attack at low temperatures rapidly reach the limit of their endurance —as a result of commitment in early phases of the attack,

troops may be weak and ineffective at the critical time. Attacks in extreme cold are directed at a series of limited objectives, and are made with superior strength with strong fire support. The firepower of indirect fire weapons can be more readily committed and maneuvered than troops in the assault echelon. The assault is made on a narrow front with maximum depth in reserves. Rapid assault requires physical exertion by the assaulting troops, which in turn hastens freezing and suffering from exposure, and results in loss of offensive power. A relief unit must be ready for commitment as soon as the objective is taken—either to organize and hold it, or to pass through to the next limited objective. Periodic reliefs are effected as frequently as is necessary until the situation is stabilized.

Reserves are normally considered 100 per cent effective until the time they are committed. In extreme cold, this is true only when the reserve troops are in shelters. A reserve which is exposed to severe cold during movement to successive positions may lose its combat effectiveness before being committed. Therefore, reserves should be provided with means of rapid movement so that they may be held in heated shelters as long as possible, consistent with time and space factors, before they are ordered into action.

Simplicity. There are no "little tasks" at 50° below zero. Every detail becomes highly important to survival and maintenance of combat efficiency. Under less severe conditions, if blanket rolls do not reach the troops at nightfall, they make the best of it by sleeping on the ground. In extreme cold, if adequate shelter is not available when needed, casualties may be apalling. Detailed operations plans must be worked out with the greatest care. Simple plans, with liberal safety factors, have by far the greatest promise of successful execution. Colonel Paul V. Kane, commanding officer of Task Force Frigid, stated: "The troop commander in Arctic operations will be required to work with an entirely new set of time factors. Operations in extreme cold require four or five times as much time as in the temperate climates." A realistic awareness of time and space factors by all commanders and their staff officers is therefore

necessary. To accomplish a result by a certain time, planning must be projected farther into the future, and necessary instructions must be issued far enough in advance. The logical conclusion is that a successful force will be engaged in doing fewer things at a time and doing them well. The simplest plan is the best plan.

The principles governing combat on any terrain have been briefly applied to operations in snow and extreme cold. It may be concluded that there are no new basic truths to be learned; rather, existing principles can be applied successfully, provided planning is thorough and realistic, and commanders give adequate consideration to the limitations imposed by extreme climatic conditions.

Organization and Principles of Employment of the Heavy Weapons Company in the Attack

The primary purpose of the heavy weapons company is to provide a tactical grouping of those heavier weapons, organic to the infantry battalion, which are essential for the close support of the assault echelons.

In World War I, there was no such unit in the infantry battalion. Close supporting weapons, principally machine guns, mortars, and howitzers, were centralized in separate weapons battalions and companies under division and regimental control. As a result of experience gained in the first World War, the tables of organization were changed to decentralize control of close supporting infantry weapons and make them organic to the using units in the infantry battalion.

In World War II, the wisdom of these changes was conclusively demonstrated by the successful accomplishments of heavy weapons companies. Centralization at the battalion level proved desirable because of the various types and calibers of the weapons, the communication and transportation facilities essential for their control and movement, and the necessity for maintaining flexibility in rendering close supporting fires to the assault rifle units.

The combat record of this company has demonstrated that this unit possesses tremendous firepower and is, in effect, the firepower backbone of the infantry battalion. In order to fully utilize the firepower of this company, the infantry leader must have a thorough knowledge of its organization and the principles governing its employment.

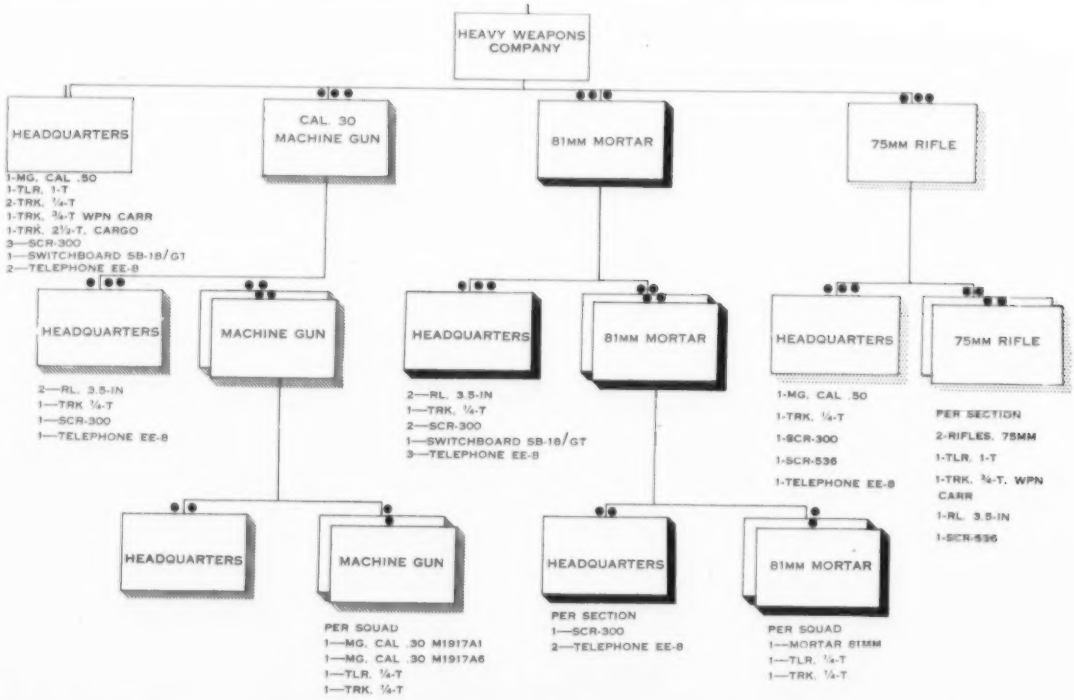

Figure 1.—Organization of the heavy weapons company.

ORGANIZATION

The elements of the heavy weapons company are: a company headquarters, a machine-gun platoon, a 75-mm rifle platoon, and an 81-mm mortar platoon. A breakdown of the company organization and a list of the important items of equipment are shown in figure 1.

PRINCIPLES OF EMPLOYMENT IN THE ATTACK

Caliber .30 machine gun platoon. There are four heavy (watercooled) and four light (heavy barrel, air cooled) machine guns in the machine-gun platoon. These are capable of delivering flat-trajectory fire at a high sustained rate. Because of their flat trajectory, these weapons are normally employed as direct fire weapons. They possess the desirable degree of flexibility in that the gunner is able to engage assigned targets or rapidly shift to targets of opportunity. The maximum effective range is about 2,000 yards, depending on observation.

Figure 2.—Each machine gun squad has a ¼-ton truck and ¼-ton trailer.

The firepower of all machine guns is used in the initial phase of the attack. However, when displacement becomes necessary, only four guns are employed in the continuation of the advance, and the remaining weapons are placed on carriers until they can be used. The decision as to which

type of machine gun (light or heavy) will be carried, depends upon the speed of the attack, the type of fire (overhead, flanking, or through gaps) most suited to the terrain and the situation, the availability of carriers, and the distance which weapons must be displaced by hand. (See figures 2 and 3.) It is apparent from these factors that if long-distance hand carry is necessary, the light machine guns will be used to follow the attack closely and support the assault echelons.

Figure 3.—Machine gun squad (less truck driver) carrying light machine gun.

75-mm rifles. There are four rifles in the 75-mm rifle platoon. These rifles have a flat trajectory and are normally employed as direct-fire weapons. While their rate of fire is limited by the ability of the crew to load, aim, and fire, experience indicates that the average well trained crew can fire about 7 rounds per minute.

In the attack, the 75-mm rifle is employed as a direct-fire weapon. Its flexibility of fires is comparable to that of other direct fire weapons. Because of the great maximum range of this weapon (7,200-7,350 yards), it may be stated, for tactical purposes, that the effective range of the weapon is ordinarily limited only by ability to observe and engage the target.

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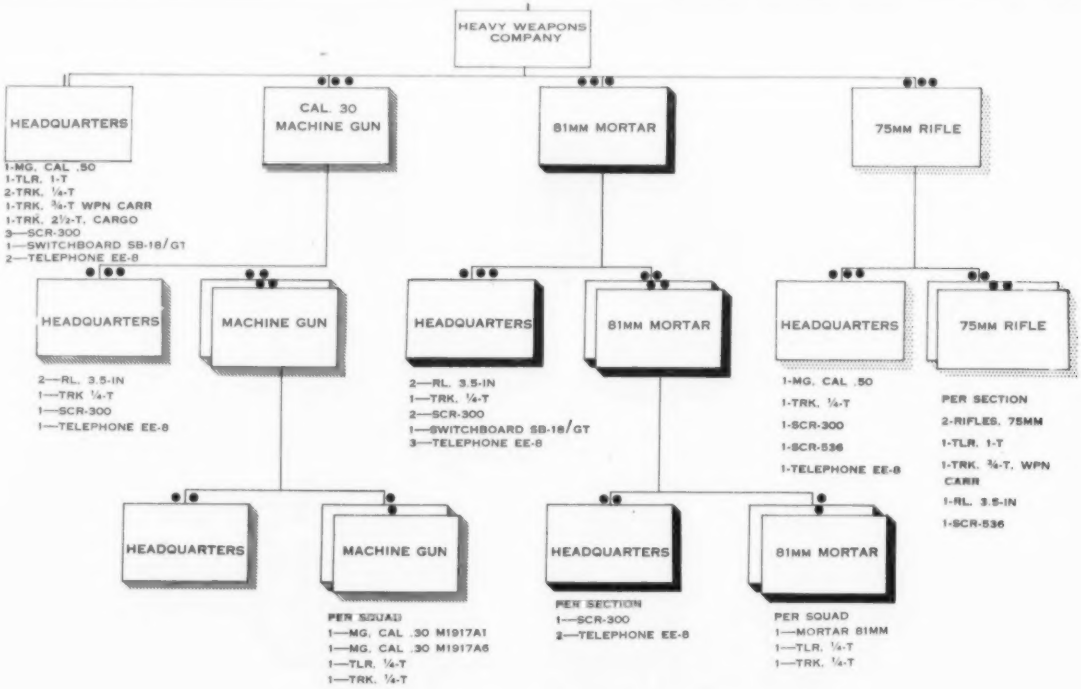

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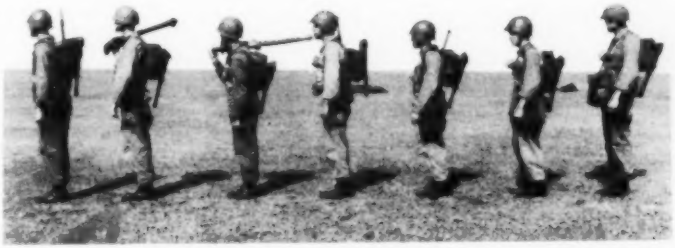

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placed on carriers until a favorable opportunity exists for their employment. (See figure 5.) The decision to employ two rifles (one per section) is usually based on an eva-

Figure 4.—Weapons, ammunition, and equipment of a 75-mm rifle section.

Figure 5.—The ammunition and equipment of a 75-mm rifle section loaded on a ¾-ton truck and a 1-ton trailer.

luation of the weight of ammunition (which restricts the number of rounds that may be initially transported), the speed and intensity of the action, and the suitability of the terrain for the use of weapons and ammunition carriers. (See figure 4.)

When possible, the 75-mm rifles are employed as a platoon, thus facilitating control and ammunition supply. Employment by platoon offsets, in a measure, vulnerability of the weapon resulting from the relatively slow rate of fire and the characteristic muzzle flash and back blast. If observation over the battalion zone does not permit adequate support from a platoon position, the responsible commander should not hesitate to separate the sections. Fields of fire, observation, and the ability to deliver timely supporting fires are the factors which determine how the platoon will be employed.

The types of ammunition for this weapon are high explosive, high explosive-antitank, and white phosphorous (smoke). Because of its exceptional mobility and versatility the 75-mm rifle, in the attack, is not normally restricted to a particular target. Remunerative targets include groups of enemy personnel, automatic weapons emplacements, field and antitank guns, vehicles of all types, and casemate embrasures. In addition, the rifles are used to engage any target that endangers the attacking troops.

81-mm mortars. There are four mortars in the 81-mm mortar platoon. These are high angle of fire weapons and are therefore capable of delivering effective fire on targets in defilade. The high angle of fire also makes it possible for the weapons to be emplaced in defiladed firing positions. While the sustained rate of fire depends upon the ability of the gun crew to lay and fire the mortar, experience indicates that the average well trained crew can fire about 18 rounds per minute.

The four 81-mm mortars normally fire as a platoon from battery positions. This employment permits effective massing of fires on point or area targets in the minimum time, and facilitates control and ammunition supply.

The effective range is usually limited by observation rather than by the maximum range of the weapon. Observation from ground observation posts is rarely effective beyond 2,000 yards. Mortar concentrations should not normally be fired less than 100 yards from friendly troops

when the range is under 1,000 yards, or less than 200 yards from friendly troops when the range is greater than 1,000 yards.

Figure 6.—A mortar squad (less truck driver) carrying 81-mm mortar.

Figure 7.—Each mortar squad has a ¼-ton truck and a ¼-ton trailer.

The service ammunition available for this weapon consists of high explosive, light, high explosive, heavy (with fuze delay, superquick, or time), WP smoke, HC smoke, and shell illuminating. Selection of the proper type of ammunition permits a variety of fire missions.

Flexibility of employment. Flexibility of employment is a characteristic of the heavy weapons company. The flat-trajectory fires of the 75-mm rifles and machine guns are

used to neutralize or destroy targets which are not in defilade. The mortars are used to supplement the fires of the direct-fire weapons, and, in addition, to engage enemy targets which are located in defilade. A skillful combination and concentration of these fires provides highly effective support for the assaulting riflemen. The degree of flexibility attained depends directly upon the ability to observe. For a fire support plan to be effective, maximum use must be made of observation posts and forward observer personnel.

MISSIONS

The mission of the heavy weapons company in the attack is to provide *close and continuous* support for the assault echelon. This mission is accomplished by utilizing the maximum available time for reconnaissance, by selecting the best obtainable observation posts and firing position areas, by selecting adequate routes for ammunition resupply, by preparing a basic plan for forward displacement, and by making full use of available communication equipment to control fires and coordinate the employment of the company.

The mission of assisting adjacent units must be considered by the battalion commander. Although the parent battalion has first priority on supporting fires, the heavy weapons company commander plans for mutual fire support to adjacent units when such assistance may reasonably be justified. Generally, a commander is best assisting the adjacent units by eliminating the targets in his own zone. When this is not sufficient, additional measures can be taken to further assist the adjacent units.

The mission of supporting a tank attack is often assigned to the heavy weapons company. Because it is difficult for tanks to protect themselves from close-in attack, they must depend on the infantry for this protection. When tanks are employed to precede the rifle elements of the battalion, the heavy weapons company renders close fire support to the tank spearhead until riflemen are in position to assume a protective role. The heavy weapons company is well suited

for such a mission. The machine guns maintain close-in fires against enemy tank-hunters, while the combined fires of the machine guns, 75-mm rifles, and 81-mm mortars neutralize or destroy enemy antitank weapons.

The mission of supporting the reorganization of the assault echelon is assumed by the heavy weapons company after the capture of the objective. Generally, this mission is accomplished by shifting fires to any area on the front or flanks of the captured objective, by displacing weapons forward promptly, or by a combination of shifting and displacing.

TACTICAL DECISIONS

Decisions concerning the tactical employment of the heavy weapons company are made by the battalion commander. While he may give specific and detailed instructions for its employment, he will consider the company commander's recommendations before rendering a definite decision. This decision includes:

The mission. When announcing the fire support plan, the battalion commander specifies the priority of fires on particular targets or target areas. Usually certain target areas are designated in the battalion order, but the platoon or section leaders select specific targets within the assigned area.

Position areas. The position areas prescribed by the battalion commander are usually based upon recommendations of the heavy weapons company commander. The fire missions assigned usually determine the approximate position areas for the weapons. The exact location of the weapons depends on the availability of observation, fields of fire, cover and concealment, routes of occupation, routes of displacment, and routes for resupply of ammunition.

Time to deliver fires. Depending upon the situation, the battalion commander may decide to fire concentrations prior to H-hour on known or suspected enemy locations, or he may decide to withhold fires until the enemy discloses his position.

Method of control. The battalion commander determines whether the elements of the heavy weapons company will

be employed in general support of, in direct support of, or attached to, the assault units.

General support. Platoons of the heavy weapons company are in general support when their fires are in support of any or all assault elements of the battalion, and are controlled by the battalion commander (normally through the company commander). Units usually remain in general support as long as control can be centrally exercised. General support affords the maximum flexibility, coordination, and concentration of fires. It is employed when there is good observation over the battalion zone and when the company commander can maintain uninterrupted communication with the platoons. General support is frequently designated in the initial phase of the attack.

Direct support. A platoon or section is in direct support when priority of its fires is accorded to a specific assault element, and when the leader of the supporting unit is responsibile for control of the fires of the supporting platoon or section. A platoon or a section may be assigned direct support missions when its fires can not be effectively controlled by the battalion commander or when it becomes desirable to allot fires to a specific assault unit. Although this method of control insures prompt and effective fire support for particular assault elements, it limits the flexibility of fires.

Attachment. When a heavy weapons platoon or section is attached to an assault rifle unit, command and control of the heavy weapons unit pass to the commander of the supported unit. The supported unit commander then becomes responsibile for the tactical employment, the fire control, and the resupply of the attached element. Units are attached when it is impractical or undesirable to employ them in either general support or in direct support. Attachment limits flexibility, but is, nevertheless, the most practical solution in many situations. Its use is particularly adapted to a pursuit operation, an independent attack mission, an attack over very difficult terrain, or a fast-moving attack.

The battalion commander makes the decisions governing the tactical employment of the heavy weapons company.

The company commander is responsible for the discipline, administration, vehicle maintenance, supply, training, and control of his company, as well as for its tactical employment in conformity with orders received from the battalion commander. The company commander is an assistant and an advisor to the battalion commander on matters relating to the employment and coordination of supporting fires, and actually, many of the tactical decisions made by the battalion commander are based on the recommendations of the heavy weapons company commander.

COMBAT RESPONSIBILITY

During combat the company commander has the continuous responsibility of supervising reconnaissance, means of control (liaison and communication), ammunition supply, and displacement of the company.

Reconnaissance. Prior to engaging his unit, the heavy weapons company commander makes as detailed a reconnaissance as time and the situation permit. He makes a careful study of the available maps and aerial photographs before a ground reconnaissance is initiated. The company commander requires his reconnaissance detail to assist in reconnoitering for routes of approach, firing position areas, routes of displacement, observation posts, a company ammunition supply point, and covered positions for carriers. This reconnaissance detail is usually composed of the platoon leaders, the reconnaissance officer, the reconnaissance sergeant, and other personnel as may be required. In order to insure specific results in the limited time normally available, the commander issues specific instructions to the reconnaissance detail.

During the attack the reconnaissance officer and the reconnaissance sergeant assist the company commander in reconnaissance, normally operating well to the front and searching for adequate routes of advance and for firing positions. The timely relay of information and recommendations from these assistants forms the basis for timely recommendations to the battalion commander concerning employment of the company. It is essential that reconnaissance be continuous throughout the action.

Means of control (liaison and communication). The company commander utilizes key personnel and communication equipment to control the fire of the heavy weapons company elements.

Personnel. The reconnaissance officer and reconnaissance sergeant maintain continuous observation and perform reconnaissance during the attack. Their reports to the company commander indicate the progress of the attack, the effectiveness of supporting fires, and the condition of the terrain to the front and flanks.

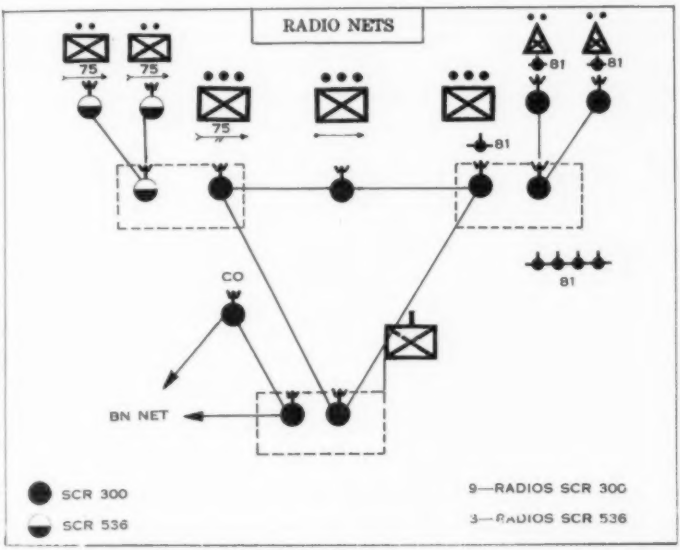


Figure 8.—The heavy weapons company radio nets.

The communication detail includes the communication sergeant (company communication chief), the bugler (assistant), three company headquarters radio operators, and four company messengers. The messengers alternate as SCR-300 operators, switchboard operators, and wire linemen.

The first sergeant usually operates the company command post. He also relieves the company commander of many

problems concerning administration, supply, and evacuation, thus permitting the company commander to devote his attention to the tactical situation.

The supply sergeant, transportation sergeant, transportation corporals, and platoon sergeant of the 75-mm rifle platoon handle the difficult problems of supply and transportation.

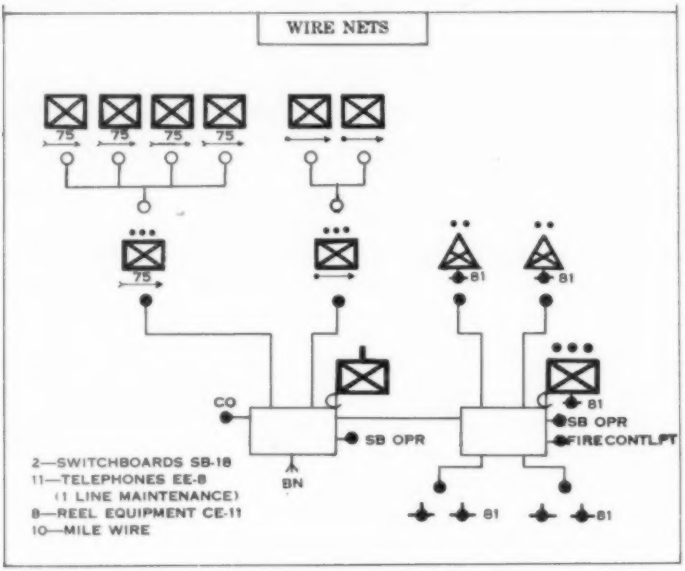


Figure 9.—The heavy weapons company wire net.

The instrument corporals of the machine-gun and mortar platoons assist their platoon leaders in obtaining fire data for the weapons, and assist in controlling platoon fires. They also establish liaison with the rifle units which their platoons are supporting.

Communications. A diagram of the heavy weapons company wire and radio nets is shown in figures 8 and 9. Variations in the illustrated communication plan may be necessary. However, the following points must be considered before effecting any changes:

The battalion net should not be abandoned.

The company net should include the headquarters of all platoons except those platoons attached to rifle companies. The fire control net should be separate from the company and battalion command nets.

Ammunition supply. The battalion commander is responsible for establishing an ammunition supply point within the battalion area from which the heavy weapons company commander can resupply his platoon. Depending on the tactical situation and the terrain, the company ammunition supply point may be near the battalion ammunition supply point, or it may be located at a more forward position. The company supply sergeant, assisted by the transportation sergeant and other personnel designated by the company commander, operates the company ammunition supply point. The platoon leader is responsible for the movement of ammunition forward from this point to his weapons. Figure 10 shows the plan (schematic) of ammunition supply utilizing the company transportation.

The resupply of ammunition during the attack may be made either by hand or by carrier. However, it is essential that vehicles be utilized to carry ammunition whenever tactically possible. In the attack, unless otherwise specified by the company or battalion commander, the platoon carriers remain under platoon control. The company commander may direct that platoon carriers revert to company control at any time.

Displacement. Heavy weapons are displaced forward when fires are masked or when it becomes necessary to decrease the distance between the supporting and supported units. Whenever possible, the battalion commander anticipates the necessity for displacement of the heavy weapons and designates advance position areas and targets or sectors of fire. Normally, the decision to displace is based upon timely recommendations from the heavy weapons company commander. It is therefore essential that prior to the attack, the company commander prepares a tentative plan for displacement and makes adequate provisions for its prompt execution.

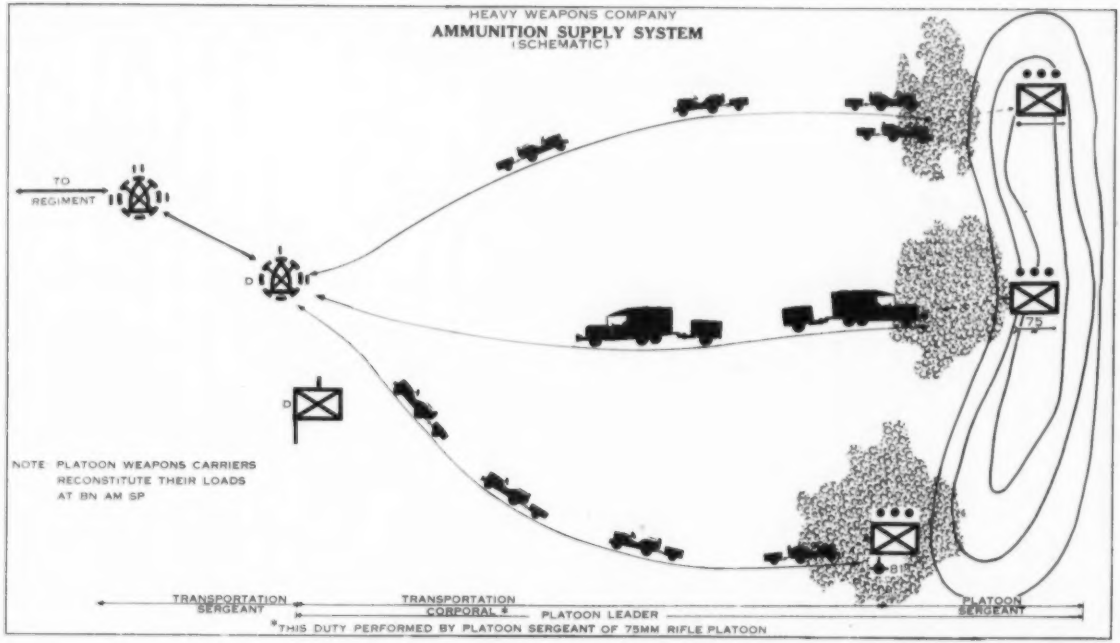

HEAVY WEAPONS COMPANY
AMMUNITION SUPPLY SYSTEM
(SCHEMATIC)
TO REGIMENT
D
D
75
81
NOTE: PLATOON WEAPONS CARRIERS RECONSTITUTE THEIR LOADS AT BN AM SP
TRANSPORTATION SERGEANT
TRANSPORTATION CORPORAL *
PLATOON LEADER
PLATOON SERGEANT
*THIS DUTY PERFORMED BY PLATOON SERGEANT OF 75MM RIFLE PLATOON

Figure 10.

Displacement may be made by hand or carrier depending on the suitability of the terrain and on enemy observation. Hand carry is practical only for short distances; for long distances—generally greater than 500 yards—carriers should be used. In order to maintain continuity of fire, the platoons usually displace by section echelon; however, under exceptional circumstances, displacement may be made by the entire platoon.

SUMMARY

During the attack the heavy weapons company must be aggressively employed in conformity with the foregoing principles. The responsibilities of the company commander include reconnaissance, control, ammunition supply, and displacement. These responsibilities must be continuously and effectively discharged by direct personal command; assistants must be utilized whenever possible. In this manner, the heavy weapons company will justify its role as the firepower backbone of the infantry battalion, and the company commander his role as an essential advisor and assistant to the battalion commander.

Operations of a Rifle Company at Brest France

(An Historical Monograph)

Early in August, 1944, General George S. Patton's Third Army broke out of the Normandy Beach Head at Avranches and struck to the east, the west, and the south. Advance was so rapid that the German defensive positions and plans were useless and the demoralized enemy resorted to concentrating his forces at key points in an effort to delay as long as possible. Some of these key points were the port cities of St. Malo, Brest, Lorient, and St Nazaire. Of these, Brest was the most important.

Brest is a city with a peace time population of approximately 85,000. It is located astride the Penfield River on the southwest tip of the Brittany Peninsula (See Map 1). The city is divided into two sections by the river; east lies the old city, ringed with an ancient moated wall constructed in the 17th century. This wall, which was constructed by Louis XIV as protection against possible invasion by England, contains many bunkers, pillboxes, and heavy gun emplacements. The old portion of the city is undermined by many tunnels and passageways which were used by the Germans as hospitals, storerooms, and underground headquarters. West of the river in the new city is the suburb of Recouvrance, which is as large as the old city. Because most of the naval installations are located in Recouvrance it is bordered by a long chain of coastal defenses extending to the tip of the peninsula. South lies the harbor in the mouth of the Landerneau River. It is protected and partially enclosed by the Crozon Peninsula, which is also heavily fortified for coastal defense.

Outside of the wall which surrounds the old city lies the more modern part of Brest, with a large business district extending to the east and ending in the suburb of St. Marc. Beyond St. Marc to the east is a series of ridges and hills which dominate the approaches to the city.

Map 1.

The VIII Corps, Third Army, under Major General Troy H. Middleton made an attempt to reach and seize Brest before enough enemy forces could be assembled within its fortifications to man its defenses. However, due to enemy resistance this was not possible, and when elements of the VIII Corps arrived in the vicinity of the city on 6 August 1944, they found it defended by a fanatical enemy prepared for a long and costly seige. It was later learned that the commander of the Fortress of Brest had been ordered by

Hitler to hold for at least 90 days in order to deny the Allies the use of this large port.

The port of Brest had been developed by the French until it was their chief naval port, and when taken over by the Germans, it had been further developed into a mighty submarine base. Therefore, the immediate capture of Brest and its port facilities was considered highly desirable by the Allies for two reasons:

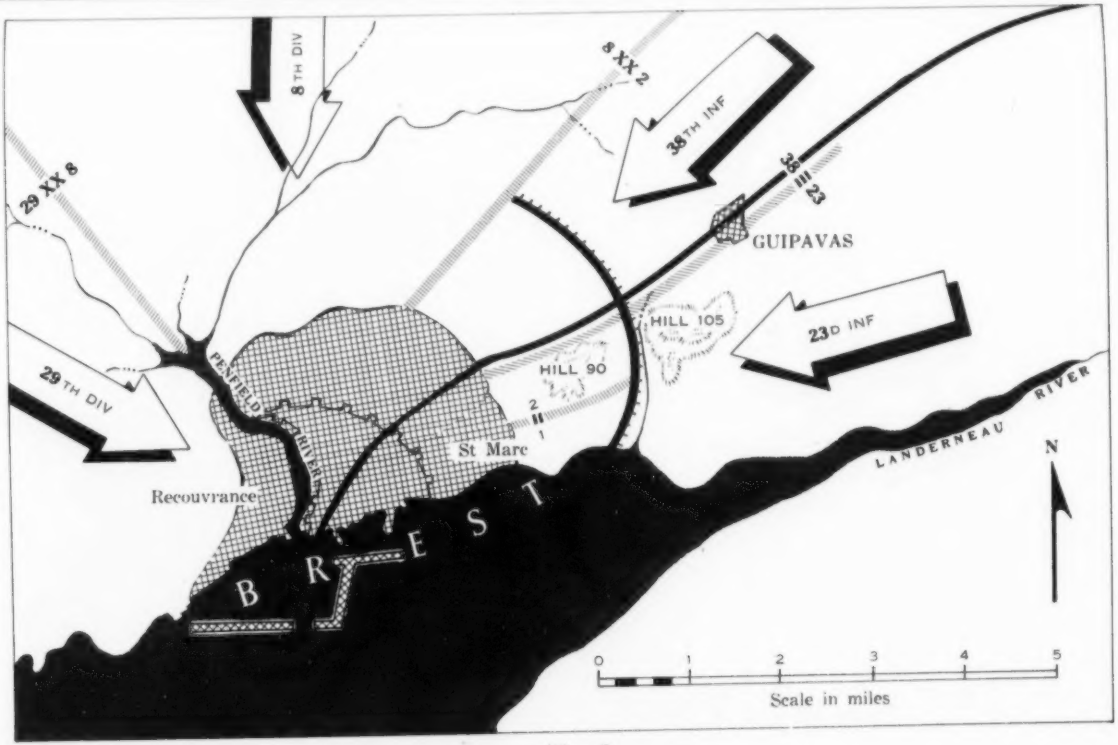
1. A large port for the landing of troops and supplies was necessary for the continuance of the European Campaign.

2. The enemy submarine base was a definite threat to Allied shipping.

Enemy forces within Brest consisted of the 2d Parachute Division at approximately 35 per cent of its normal strength, and the 266th and 343d Infantry Divisions (See Map 1). Reinforcing these divisions were naval and marine units. Enemy artillery in support of the garrison was estimated as eleven battalions—mostly 88-mm and 105-mm—including the artillery regiments of the 266th and 343d Infantry Divisions and the 2d Parachute Division. Also, heavy coastal guns were pointed inland to aid the defenders. The total strength of these forces was estimated to be approximately 50,000 men under the command of Major General Herman V. von Ramecke, former commander of the 2d Parachute Division.

The U.S. VIII Corps, which was to attack Brest, consisted of the 2d, 8th, 29th, and 83d Infantry Divisions and the 6th Armored Division. Three of these divisions were disposed to form an arc around the city with the 29th Division on the right (west), the 8th Division in the center (north), and the 2d Division on the left (east).

The corp plan of attack was for these three divisions to attack Brest simultaneously while two task forces were committed to clear the Crozon and Daoulas Peninsulas. The attack was to be preceded by a 20-minute artillery preparation. For the final phase of the attack the 2d Division was designated to mop up the city.


8 TH DIV
8 XX 2
38TH INF
29 XX 8
III 23
GUIPAVAS
HILL 105
23D INF
29 TH DIV
HILL 90
2
II
1
St Marc
Recouvrance
LANDERNEAU
RIVER
N
B R E S T
0 1 2 3 4 5
Scale in miles

Map 2.

During the period 19 to 25 August the 2d Division moved into position for the attack and began to feel out the enemy defenses. Task Force B was assigned the mission of clearing the Daoulas Peninsula so that the coast artillery guns could not be fired into the flank of the 2d Division as it moved in on Brest.

On 25 August an attack was launched upon the outer ring of fortifications. On 5 September VIII Corps was detached from Third Army and assigned to the newly activated Ninth Army under Lieutenant General William H. Simpson, but the corps mission was unchanged. By 8 September the outer defenses had been cracked, and the 2d Division was in position to launch a drive into St. Marc and Brest.

2D DIVISION PLAN OF ATTACK

The division plan of attack was to strike to the west with the 23d Infantry Regiment on the left, the 38th Infantry Regiment on the right, and the 9th Infantry Regiment in reserve. (See Map 2.) The assault regiments were to push through St. Marc up to the wall of the old city and then prepare for a final assault on the strongly-held position.

The 23d Infantry Regiment was to attack with two battalions abreast with the 1st Battalion on the left and the 2d Battalion on the right. The 3d Battalion was to be held in reserve.

The plan of the attack for the 2d Battalion, 23d Infantry Regiment, was to attack with Company F on the right, Company G on the left, and Company E in reserve. (See Map 3.) One platoon of heavy machine guns from Company H was attached to each of the two assault companies. The 81-mm mortar platoon was in general support of the battalion. The battalion's initial objective was Hill 90 just outside of St. Marc. After securing this hill the attack was to continue into St. Marc upon order from the battalion commander.

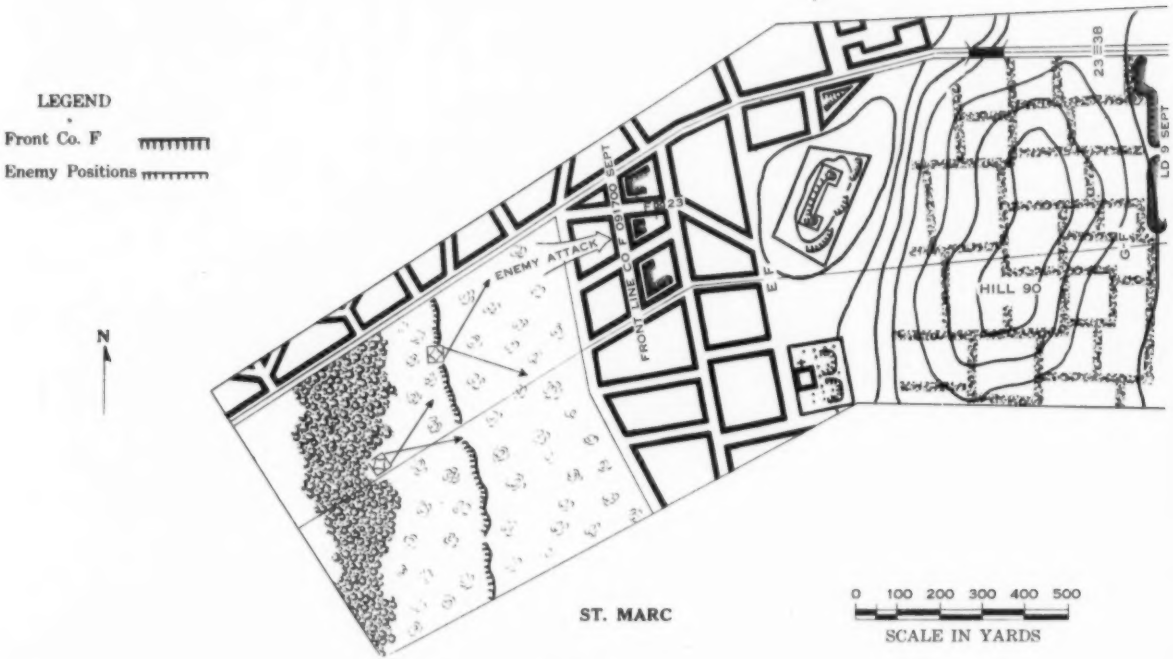
SITUATION OF COMPANY F, 23D INFANTRY

On 8 September 1944, Company F, 23d Infantry Regiment was occupying a defensive position on Hill 105, for which, six days before, it had fought a bitter two-day battle. At about 1800 hours orders were issued effecting relief of the 2d Battalion by the 3d Battalion, 23d Infantry. The 2d Battalion was ordered to move to an assembly area in rear of the eastern slope of Hill 105 and, during hours of darkness, to relieve the 2d Battalion 38th Infantry Regiment which was located on the low ground between Hill 105 and Hill 90.

By the time the relief between the 2d and 3d Battalion, 23d Infantry was accomplished and the move to the assembly area completed, darkness had set in and it was impossible to make a complete reconnaissance of the area in which the night relief of the 2d Battalion, 38th Infantry Regiment was to take place. The relief was to be company for company; thus Company F, 23d Infantry was to relieve Company F, 38th Infantry.

While Company F was moving forward under the command of the company executive officer, the company commander went forward and contacted the commander of Company F, 38th Infantry. He made arrangements for guides from each platoon in position to lead the platoons of the relieving company into position and to orient them on the situation before withdrawing their troops from the area.

Company F, 23d Infantry moved into the area occupied by Company F, 38th Infantry at 2115. A great deal of confusion existed because both companies were designated as Company F. Control and communication were difficult in the darkness. The officers and noncommissioned officers of Company F, 23d Infantry, who did not have time to reconnoiter the area in daylight, were wholly dependent on the guides furnished by the unit being relieved. To make matters more difficult, many of the noncommissioned officers of the unit being relieved had little or no knowledge of the enemy situation or the terrain to the front. The relief was finally completed at 2300 hours.


LEGEND
Front Co. F
Enemy Positions
N
ENEMY ATTACK
FRONT LINE CO F 0900 SEPT
23
E F
HILL 90
23
38
LD 9 SEPT
ST. MARC
0 100 200 300 400 500
SCALE IN YARDS

Map 3.

The strength of the company at this time was about 170 enlisted men and 7 officers. Approximately 30 per cent of the company were veterans who had landed at Omaha Beach on D plus 1. The other 70 per cent were seasoned replacements who had seen considerable combat in Normandy and Northern France.

Of the seven officers the company commander was the only one who had landed with the company at Omaha Beach on D plus 1. The rest were replacements but they were combat seasoned, courageous, and capable. Morale, discipline, and esprit de corps were excellent. The company had been very successful in all previous combat operations and the men had developed a deep sense of pride and loyalty to the unit.

Orders to attack at 0630 the following morning were received soon after Company F, 23d Infantry occupied the position. Since the scheduled hour was before dawn and since the men had no visual conception of the terrain to the front, it was difficult to plan the attack. Another disadvantage was the fact that although the company was to engage in a major attack, the men were unable to rest due to the lateness of the hour at which the relief was completed. However, preparations for the attack were completed in the early morning hours and Company F was ready to move out at 0630, 9 September.

The line of departure was a hedgerow which extended across the front and was perpendicular to the direction of the attack. (See Map 3.) The company formation was to be two platoons abreast with the 3d Platoon on the right and the 2d Platoon on the left. The 1st Platoon, in support, was instructed to follow the 3d Platoon by bounds, keeping under cover as much as possible. One light machine-gun squad from the weapons platoon was attached to each of the two assault platoons. The 60-mm mortar section was to remain in position and support the company by firing on targets that appeared after the attack started. Because they had no positions from which to fire, the attached platoon of heavy machine guns from Company H was to follow the support platoon. There was to be no

artillery preparation on Hill 90 prior to the attack because surprise was desired.

THE ATTACK

At 0630, 9 September, Company F crossed the line of departure. The men moved out slowly, and then cautiously worked their way through enemy barbed wire entanglements which had been blasted by artillery on previous days. As the advance continued and no opposition was encountered, they moved forward more quickly, encouraged by the prospect of taking Hill 90 without a battle. As the leading elements neared the crest a few scattered shots were fired but the troops continued to advance and soon reached the top of the hill. The assault platoons found that the enemy forces had withdrawn during the night leaving only a few men as a covering force. Some of the covering force surrendered and the remainder withdrew to the next line of defense.

Companies F and G arrived at the top of Hill 90 simultaneously and prepared to consolidate their positions behind the hedgerows running along the crest of the hill. The enemy had withdrawn across a deep draw which had almost perpendicular sides, and had occupied positions on the high ground in the eastern fringe of St. Marc. At this time the assault companies along the top of Hill 90 were subjected to a heavy volume of machine-gun and rifle fire. Enemy artillery also opened up on the newly-won positions, but most of the rounds landed in front of or behind Company F.

At about 0900 Company F received orders to continue the attack and move on into St. Marc. Elements of the 38th Infantry which were on the right of Company F were across the draw and almost into St. Marc. Their left flank was about even with the enemy positions to the direct front of Company F. The commander of Company F moved the attached heavy machine-gun platoon into position with the two front-line platoons and directed all available fire power on the enemy positions. At the same time he sent the support platoon around the right slope of Hill 90 to

cross the draw behind the left flank of the 38th Infantry and to attack the enemy positions from the flank. This maneuver was successful and the 1st Platoon succeeded in obtaining a strong foothold on the left of the 38th Infantry, thus eliminating some of the fire on the other platoons. The 3d Platoon was directed to shift to the right behind a hedgerow and infiltrate across the draw to join the 1st Platoon.

The main enemy position was in and around a large chateau that stood on a knoll. With the 3d Platoon as a base of fire, the 1st Platoon assaulted this chateau and succeeded in capturing or killing all of the defenders. Among the twenty-four prisoners taken were two German officers who were in charge of the defense of the portion of the line in F Company's sector.

With the taking of this position the outer ring of the enemy defense was pierced and the way into St. Marc was open.

Company G, 23d Infantry was still on Hill 90 and was unable to move forward in their zone because of enemy fire from positions in a large cemetery across the draw. To support the advance of Company G, the 2d Platoon, Company F moved to the left (south) and succeeded in getting behind the enemy. From this position they concentrated their fire on the flank of the enemy position and inflicted heavy casualties. Company G, however, was still unable to cross the draw.

In order to make the most of the successes already attained, Company F continued the attack into St. Marc, guiding to the left of the street which was the boundary between the 23d and 38th Infantry Regiments. At this time Company F 23d Infantry and Company L 38th Infantry were the only two attacking units in St. Marc. The other companies were held up by the enemy.

To exploit the advance made by Company F, the battalion commander ordered Company E, then in reserve, to follow Company F into St. Marc, extend on the left flank of Company F, and perform the mission originally assigned to Company G. Since Company G was unable to overcome

the enemy resistance in the cemetery, they were ordered to bypass the cemetery and to follow Company E.

Company F moved into St. Marc with two platoons abreast, the 3d Platoon on the right, the 1st Platoon on the left, and the 2d Platoon in rear of the 1st Platoon to protect the exposed left flank. Houses and other large buildings in the area made it difficult to maintain control and at the same time search out enemy positions and hiding places. However, the forces to the front seemed to be withdrawing and Company F advanced steadily. Approximately 200 prisoners, mostly Italians, Poles, and Russians who were in the German Army, were captured during the advance.

By 1700 hours Company F had advanced 1,200 yards against the enemy and was ordered to halt and prepare to defend for the night. (See Map 3.) Preparing the defensive position consisted of placing platoons and squads in houses and buildings from which they could cover the streets running across the front and the streets and alleys leading into them. Heavy machine guns of the attached machine-gun platoon were brought forward and placed in windows and doorways from which they could cover the streets to the front. The company command post was located in a cellar at the rear of the defended area. (See Map 3.)

Company E moved into position on the left of Company F just before dark, and the two companies coordinated their defense. Thus, Company F had protection on both flanks and a company frontage of about 400 yards. In conformity with the company SOP, the additional communication equipment was brought forward and installed before dark. The equipment consisted of two SCR-300 radios, one small 8-drop switchboard (German), five German telephones similar to the EE-8, twelve sound-powered telephones, and six SCR-536 radios. This equipment, with the exception of the radios, was carried on the quarter-ton truck and trailer which carried the extra ammunition and closely followed the company. The truck was under the control of the company supply sergeant.

The communication system was operated by the communication sergeant and eight men from company headquarters. When the company halted, wire communication was established with all platoons and from platoon headquarters to their squads and outposts. Any disturbance along the company front was immediately reported, through platoons, to the company command post. When installed, the company switchboard and the platoon headquarters phones were constantly attended by personnel on duty. The lines were checked every half hour during the night, and if a line went out, radio contact was established until repairs were made.

In keeping with the policy of serving the men a hot meal as soon as possible after halting for the night, supper was brought forward from the regimental train bivouac area and was taken to the platoons by carrying parties. Hot coffee accompanied the food, and water was brought up to fill canteens. Extra ammunition was delivered to the platoon areas and distributed under the supervision of the platoon guides.

An outpost established by the 3d Platoon reported enemy activity to its front at about 2300 hours. A few minutes later a strong enemy force forced the outpost to withdraw to the platoon defense area. Fortunately, the company had been alerted by the outpost and was ready to meet the attack. (See Map 3.)

A heavy volume of rifle and machine-pisol fire accompanied by a shower of hand grenades came from buildings across the street. The 3d Platoon returned the fire and retaliated with fragmentation grenades. This exchange lasted for approximately 30 minutes then ceased abruptly as the attackers withdrew.

The platoon leader reported that casualties within the platoon consisted of two men killed and three slightly wounded. Unfortunately, the men killed were the platoon sergeant and the platoon guide. The death of these two men was a great loss to the unit as both were battle-wise veterans, having landed with the company on the Omaha Beachhead as privates. Their positions were filled by the two senior squad leaders.

At about 0430 orders were received to continue the attack at 0900. Company E was to attack on the left and Company L, 38th Infantry on the right. Since the 3d Platoon had been hit rather hard by the loss of its platoon sergeant and platoon guide, the company commander decided to pass the 2d Platoon through the 3d Platoon when the attack started. The 3d Platoon would follow closely in support to assist in mopping up behind the two assault platoons.

At 0900, 10 September, the company moved forward and succeeded in crossing the street and moving into the buildings without opposition. The company front at this time extended across two rather small blocks of buildings, all joined together and solidly built.

Progress was slow due to difficulty in finding doorways or passages from one building to another. The streets running in the direction of advance were swept by enemy machine-gun fire and covered by snipers. The only way to cross the street was to throw a smoke grenade and then dash through the cloud of smoke to a covered position on the other side.

After advancing about 200 yards the company moved through the building area and faced a large, open expanse of lawn and shade trees. This park was approximately 800 yards wide and extended completely across the front of Company F and part of Company E on the left. (See Map 3.)

It was evident that the enemy had set up a strong point on the far side of the park. A large structure which appeared to be a concrete pillbox with a system of trenches extending on either side could be seen with binoculars. It was decided to feel out the position and a volley was fired. The enemy returned fire from the pillbox and other points all along the trench system. The park appeared to be a strong defensive position as there was absolutely no cover or concealment for attacking troops. After looking over the situation the company commander requested artillery on the enemy position.

Artillery fire was placed on the position but it seemed to have little effect. A section of tank destroyers with three-inch guns was attached to the company and ordered to move into position in rear of the assault platoons. The officer in charge came forward and the pillbox and other likely targets were pointed out to him. The tank destroyers then moved into firing position and placed direct fire on the enemy position. The company moved forward under cover of the fire of the tank destroyers and a platoon of heavy machine guns which had been placed on the second floors of the buildings just cleared.

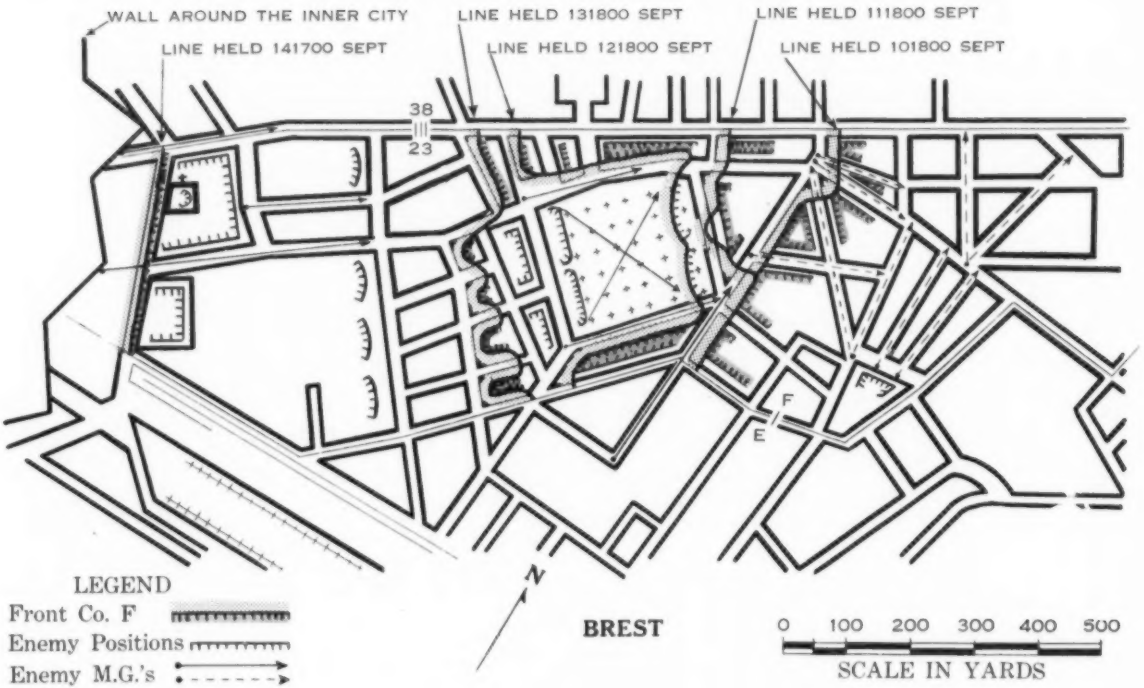
Under cover of the supporting fires, the two assault platoons succeeded in reaching the pillbox and the trenches. They quickly mopped up the enemy troops in the area, killing many and taking a few prisoners.

The 1st Platoon then came under fire from another concrete emplacement about 200 yards to the front. The platoon sergeant contacted one of the tank destroyers and directed its movement into position to fire on this new threat. The enemy position was completely destroyed by the powerful gun of the tank destroyer.

Again the company moved forward through a small wooded area and up a gradual slope to a highway which branched to the south from the main street which formed the boundary on the right. In this advance, assault fire was used, and all rifles, submachine guns, and automatic rifles spouted a stream of lead into possible enemy positions to the front. As a result of this protective fire very little enemy resistance was encountered as the leading elements advanced into the area of large buildings.

The company crossed the road and moved into the buildings where the advance was halted temporarily for reorganization. Because the SCR-536 radios did not function properly inside of buildings, it was necessary to lay wire forward to the assault platoons to provide a dependable method of inter-company communication.

As the company resumed the advance snipers in the higher buildings to the front and from the basement windows


WALL AROUND THE INNER CITY
LINE HELD 141700 SEPT
LINE HELD 131800 SEPT
LINE HELD 121800 SEPT
LINE HELD 111800 SEPT
LINE HELD 101800 SEPT
38
23
F
E
N
BREST
LEGEND
Front Co. F
Enemy Positions
Enemy M.G.'s
0 100 200 300 400 500
SCALE IN YARDS

Map 4.

of buildings facing open areas and road junctions, became very active. The enemy was attempting to hold some buildings in the center of the block, and the fighting was almost hand to hand within the contested buildings. In this kind of fighting submachine guns and fragmentation grenades were very effective.

By 1800 the company had cleared several blocks of buildings and was facing a large walled cemetery which occupied more than a city block. The cemetery had wide streets around its walled area and was flanked by long rows of high buildings on all sides. The assault platoons encountered fierce resistance from positions within the cemetery and along the streets, and from the upper floors of the surrounding buildings. (See Map 4.)

After a total gain of about one mile during the days fighting, Company F was forced to go into a defensive position for the night. Casualties within the company had been light, but heavy losses had been inflicted upon the enemy. About forty prisoners were taken, including naval, paratroop, and air force personnel.

At about 2000, the enemy coast artillery shelled the company position with large caliber shells, judged to be about 280-mm. Several houses were completely destroyed and hits on buildings containing men from the 2d Platoon caused several casualties. This was reported to battalion headquarters and supporting artillery soon replied with counterbattery fire which silenced the enemy guns.

Orders were received at 0700 on 11 September to continue the attack at 0900.

Prior to the attack the 81-mm mortar platoon and the company 60-mm mortar section fired concentrations in and around the cemetery, but due to the heavy wall and the well-protected positions occupied by the enemy, the fire was not very effective. At 0900 the company attacked. The 2d Platoon objective was the right half of the cemetery and a row of buildings further to the right. The 1st Platoon objective was the left portion of the cemetery and the row of buildings on the left. The 3d Platoon, in support, was to

assist in mopping up. The machine-gun platoon was to support the attack from positions on the upper floors of buildings. However, their sector of fire was limited by the heavy wall around the cemetery.

Both assault platoons were initially successful in gaining footholds in the buildings on both flanks, and a squad from each platoon moved into the edge of the cemetery through gaps which had been blown in the wall during the night by the heavy shells from the enemy guns.

Here the advance was stopped by heavy enemy fire from positions in the far edge of the cemetery. Some of the enemy weapons were emplaced in large stone burial vaults built above the ground, while others were dug in along the streets and at the corners. Enemy machine guns commanded the streets to the front and also crossed fire along the walks within the cemetery. These walks traversed the cemetery at all angles and thus provided the enemy with excellent fire lanes. Ricochets from the tombstones and flying splinters from the granite slabs which entirely covered the surface of the cemetery caused several casualties and forced the two squads within the cemetery to withdraw to the protection of the wall at the outer edge. (See Map 4.)

The advance through the row of buildings on either side was halted by lack of doorways or passages between the buildings, and the streets were impassable because of enemy machine-gun fire. Heavy firing by both sides continued throughout the day but no further advance was made. At 1800 Company F was occupying small sections in the buildings on the right and left flanks and had two squads just within the cemetery wall.

Company E on the left and Company L, 38th Infantry on the right had also been held to short gains during the day. All assault companies were generally on a line.

At about 2200 a meeting of the company commanders was held at 2d Battalion Headquarters and plans were made for the next day's attack. It was decided to attach one platoon of Company G to each assault company in order to give each assault company an extra platoon for support and

mopping up when the initial breach was made in the enemy defense. It was also recommended that the attached tank destroyers be used whenever possible against enemy fortifications. The attack was again set for 0900 the next morning and was to be preceded by 81-mm mortar concentrations fired along the edge of the cemetery.

Through interrogation of prisoners at regimental headquarters, it was learned that the cemetery in front of Company F was held by 220 men from the 2d Parachute Regiment who had been ordered to defend to the last man.

The plan for the attack on 12 September was for the 1st and 2d Platoons to capture the buildings to the right and left of the cemetery, while the 3d Platoon maintained steady fire on the enemy troops in the cemetery.

A plan to move through the interior of the buildings by blasting holes in the partitions was agreed upon, and four demolition men from the Ammunition and Pioneer Platoon of Battalion Headquarters Company were attached to Company F. A large supply of TNT was moved into the company area during the night and preparations for putting the plan into effect were completed.

An enemy self-propelled weapon moved up after dark and fired several rounds of direct fire into the buildings occupied by the company, but no casualties were inflicted. At intervals during the night the enemy gunners fired streams of tracer bullets along the streets and across the cemetery. Our own artillery, which had been firing almost continuously since the attack started, pounded the heart of the city throughout the night. The almost constant exchange of artillery was rapidly reducing the city and its port facilities to rubble.

The attack was resumed at 0900 the next day, 12 September, and fierce resistance was again met all along the front. The plan of blasting holes in the interior walls of the buildings on the right and left met with remarkable success. As quickly as the holes were blasted the men poured through into the next section, often taking the enemy by surprise,

then advanced to the next barrier where the blasting operation was repeated. Although this method was comparatively slow, it resulted in fewer casualties than would have been incurred in a direct frontal attack.

By late evening the 1st and 2d Platoons had gained control of the buildings on both sides of the cemetery as far forward as the streets at the far edge of the cemetery. After seizing the buildings which commanded the cemetery and the streets leading into it, the two platoons had a sniper's holiday picking off the enemy whenever they exposed themselves. However, a small enemy force held out and Company F spent the night of 12 September in the buildings surrounding the cemetery. (See Map 4.)

Except for the friendly artillery which fired relentlessly on the inner city, the night passed quietly. In the darkness it was difficult to get food and ammunition to the two forward platoons as the carrying parties had to thread their way through many doorways, passages, and holes. Carrying parties from company headquarters and the support platoon worked far into the night moving the necessary supplies forward.

The attack continued the next morning, 13 September, at 0900, with the 3d Platoon advancing through the cemetery against slight resistance, thus straightening the company front. The 1st and 2d Platoons started to advance abreast through the buildings in the next block. Progress was slow because it was still necessary to blast holes through the walls of the buildings as the streets to the front were still covered by enemy machine-gun fire. Small isolated groups in strong points and snipers in the windows of tall buildings continued to resist.

In an attempt to support the advance of the 1st Platoon, the 81-mm mortar platoon fired several concentrations of high explosive ammunition on enemy positions. One of these concentrations fell short and several rounds landed within a courtyard in the 1st Platoon area. The platoon leader and one of his squad leaders were slightly wounded so an unassigned officer in the company was placed in command of the 1st Platoon.

Tank destroyers were used to fire on buildings at street intersections, to dislodge snipers, and to knock out machine guns which were usually emplaced so they could maintain grazing fire for several blocks down the street and across intersections.

The advance continued slowly but steadily for two blocks, but then the assault platoons were halted by a series of burning buildings across the entire front. In a desperate effort to halt the advance, the enemy had set fire to the buildings in the path of advance. Since it was impossible to move through the blazing buildings, the troops were halted until the fires burned out. Fortunately, the area occupied by Company F did not catch fire or they would have been forced to withdraw. The fires burned all afternoon and most of the night; meanwhile the company rested and prepared to continue the attack when possible. (See Map 4.)

At 0845 hours on 14 September, the company advanced through the burned area, which was about one block in depth and extended the width of the company front. The buildings were still hot and smouldering, but some areas were passable. The walls which were still standing provided protection for the men as they advanced.

After crossing the burned area the company moved into an area of buildings where groups of the enemy still controlled the street intersection from well-emplaced positions. One of these enemy positions was a large church with a high dome which afforded concealment for many riflemen. (See Map 4.) This building, about one block from the wall of the old city, was believed to be the last enemy stronghold outside of the wall.

By 1000 Company F was halfway through this block, but progress was slow and much demolition was necessary. In the 1st Platoon sector it was necessary to blast through seven walls to destroy the last enemy position.

By 1300 all the area before the wall, with the exception of the church on the right, was held by Company F. An assault on the church by the 2d Platoon was successful, and by 1700 the church was cleared of the enemy and Company F was facing the wall of the inner city.

Just before dark the 3d Battalion, 23d Infantry, relieved the 2d Battalion, Company K relieving Company F. The relief was completed by 2130 and the men of Company F marched back through the streets for which they had fought. Their part in the battle for Brest was ended, and they moved into an assembly area in St. Marc.

Four days later, on 18 September, the German defenders of Brest capitulated and all resistance ceased. The fortress city which was to be held for ninety days, fell in twenty-one.

ANALYSIS AND CRITICISM

The capture of Brest was ordered to secure a large port for the use of the Allies. However, during the ensuing battle it was completely destroyed and consequently was of no military value for the duration of the war. It is debatable whether Brest, as a military objective, was worth its cost in men and materiel; it was a costly lesson to the Allies and an inestimable loss to France.

The method employed was a coordinated attack upon the *entire* perimeter of defense after several days of maneuvering outside the city. This seems to have been a waste of manpower; a concentrated effort upon a narrow front would have penetrated the defense, permitting the other positions around the perimeter to be taken from the flank and rear with less difficulty and fewer casualties.

In this type of operation the men of the assault echelons must be imbued with an offensive spirit if the desired results are to be obtained. At the time this action took place, the men of Company F had been participating in a series of successful offensive campaigns and, as a result, possessed an offensive spirit. There was no doubt in their minds as to the outcome of the battle—they were convinced that they could defeat the enemy.

The element of surprise was lacking at the beginning of each day's offensive because the same hour of attack was used. However, once the assault was underway, surprise was obtained by flanking maneuvers, by superior fire power, and by the use of all available means to gain avenues of approach into the enemy positions.

Formations used in the attack were basically the same as for any other operation. Within the company the most successful formation was two platoons abreast with one in close support. The emphasis was placed on employment of small units under the direction of squad and platoon leaders. This procedure developed the leadership of junior officers and noncommissioned officers.

Direct-fire weapons such as tank destroyers and self-propelled guns were used to furnish close support to the assaulting troops. Because of the height of the buildings and the proximity of the attacking and defending troops, supporting artillery could not be used in its normal role.

The success of this operation was due to the close cooperation between units:

1. The Air Force conducted bombing missions against fortified areas and supported ground troops by dive bombing and strafing.

2. The artillery, by use of long range fires, disrupted the enemy communications and supply lines, and limited the movement of troops within the city.

3. The engineers cleared mines and booby traps from streets and buildings, cleaned debris from the streets, and performed demolition work.

4. The service forces brought supplies from the Omaha Beachhead to support the operation.

5. Medical units cared for the sick and wounded in field hospitals near the combat zone.

6. As always, the infantry closed with the enemy, defeated him, and took the ground.

LESSONS

1. In street fighting it is necessary to reduce the frontage of attacking units due to the density of the area to be cleared.

2. A concentrated attack upon a narrow front is more effective than a general attack on the entire perimeter of the defensive position.

3. Communication and control are difficult. SCR-536 radios are frequently useless inside of buildings. Wire must be laid by assault platoons.

4. The same hour should not be used for every attack—this results in the loss of surprise.

5. The use of an important port can be denied to the attacking force by a determined defense and by the extensive use of demolitions.

6. An extra allowance of special weapons such as submachine guns, automatic carbines, and automatic rifles is desirable in city fighting. They give the men confidence and provide fire power where it is most needed.

7. Special maps marked with check points and showing the detailed plan of the city should be furnished all assault units. Streets should be used for phase lines in order to maintain control.

8. The best avenue of approach into the enemy positions is through the interior of the buildings.

9. Tank destroyers can reduce enemy strong points by direct fire.

10. Setting fire to the buildings in the path of attacking forces is an effective method of halting their advance for a considerable length of time.

11. The relief of a front-line company engaged in city fighting should be made during daylight hours. This is necessary because the routes forward are difficult to follow during hours of darkness. Even during the daylight hours, enemy observation is limited and covered routes forward are usually available.

Attack of a River Line

Although the importance of river crossing operations was fully realized during the period between the two World Wars, relatively little training in this type of operation was conducted by infantry units. This was possibly due in some measure to the fact that few river crossings were made in the First World War, but more compelling reasons lay in the infrequency with which training exercises involving combined arms were conducted and the even more infrequent access to a suitable stream when they were.

The fast moving situations of the Second World War made it immediately apparent that river crossings, whether on a large or small scale, had to be made frequently. Out of necessity, many units became proficient in the technique of attacking a river line and developed SOPs that were as effective as the offensive plays of a well-coached football team. Contributing to the success of these units were farsighted infantry and engineer officers who realized that through coordination between their two branches, river crossings could be accomplished with a minimum of delay and casualties. Thus the obscurity that surrounded this special operation was lifted.

Rivers have long been considered important military terrain features because they are natural obstacles to the attacker and natural lines of resistance for the defender. They frequently determine the location of strong defensive lines or delaying actions. A river line is defined as the water's edge on the defender's side of the river; therefore, from the attacker's viewpoint, the far side.

In general, there are four types of river crossings: a crossing of a river line not held by the enemy, a crossing made to reinforce advance troops, and attack of a river line lightly defended, and an attack against a river line which

is strongly defended by the enemy. If the principles governing the execution of a river crossing against a well organized defense are understood, no new problems are encountered in training and planning for any other type of crossing. For this reason, this article discusses crossings made against strongly defended river lines.

PRINCIPLES AND DOCTRINE

The primary mission of the assault units in an attack of a river line is to establish a bridgehead on the far bank. This bridgehead is a position held by advance forces beyond a river line to protect the passage of the remainder of the command; the unit or units establishing it may be ordered to continue the attack or may be passed through by fresh troops when its mission has been accomplished.

Strike the enemy on a broad front. The assault should be launched on a broad front and the plan of attack must be kept highly flexible so as to permit exploitation at those points which promise the most success. The attacker selects a probable main crossing site as well as other sites and, after the attack is launched, he diverts his reinforcements to the site enjoying the greatest degree of success. This site then becomes the main site. The crossing at each site is made by a completely organized force so that the attacker is prepared to fully exploit success at any point where a foothold is obtained.

Crossing on a broad front also enables the attacker to gain a degree of tactical surprise by deceiving the defender as to the location of the main crossing site. Thus the defender is forced to disperse his forces to counter an attack at several points along the river line and is forced to make plans for reinforcing these points with a mobile reserve even after the main crossing site has been disclosed. A broad front increases the speed of the crossing because it permits more troops to cross simultaneously in well dispersed formations. It affords the attacker more maneuver room on the defended bank and makes it possible for him to outflank troublesome strong points.

Infantry unit frontages are normally greater than in other offensive operations. Frontages assigned assault units employed in forcing river crossings are usually much greater than in other operations; however, the actual frontage assigned to such a unit depends on the type of resistance expected, the terrain on the far bank, the known disposition of the enemy, and the number of available crossing sites. Wide frontages enable the assault boats to cross well dispersed and thus present a less vulnerable target to the enemy. Because it is difficult for attacking units to function successfully for long periods of time with such wide frontages, units converge toward their objectives and thus narrow their zones as the attack moves inland.

Thorough technical and tactical reconnaissance are necessary. Much of the success or failure of a river crossing operation is determined by the thoroughness and accuracy of reconnaissance. Technical reconnaissance is made by engineers to determine the most suitable location for crossing and bridge sites; they study the formation of the river line; the approaches on both sides of the river; the structure of the river banks; the speed of the current; and the width and depth of the river. The troop commander responsible for executing the crossing makes a tactical reconnaissance to determine the feasibility of seizing and holding the bridge site or sites desired by the engineers.

Reconnaissance is deceptive, detailed, and continuous. When practicable, reconnaissance is initiated long before reaching the river by the use of aerial photos, maps, and observation aircraft and by interrogating civilians. As the river is approached, these sources of information are supplemented by patrols operating on both sides of the river. Commanders of all units seek suitable locations for rear assembly areas, routes to forward assembly areas, forward assembly areas, routes for movement of the individual boats forward to the river bank, and positions for supporting weapons on the enemy side of the river. All commanders are concerned with the enemy strength, composition, and dispositions, and with locating objectives and routes thereto.

Zones of action on both sides of the river and axes of communication and routes for supply must be determined.

The tactical commander decides where the crossing will be made. After both tactical and technical reconnaissance are completed and the engineer plan is submitted, the commander responsible for establishing the bridgehead makes the decision as to where the river will be crossed.

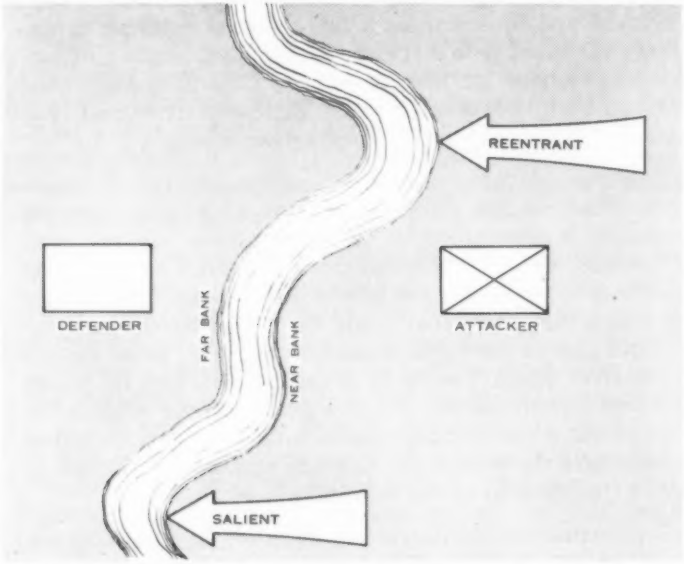


FIGURE 1.—Crossing at a reentrant is advantageous to the attacker.

A reentrant is the preferred crossing site. (See figure 1.) The geometric pattern of the river bed is an influential factor in choosing the crossing site. A long stretch of river line running generally perpendicular to the direction of attack is avoided because it usually affords the defender long fields of uninterrupted grazing fire and better flanking fire on the attacking troops. Conversely, crossing at a reentrant—a bend of the river away from the defender's line—is advantageous to the attacker. Once the crossing has been made, the line that must be occupied to establish the beachhead is shorter and the flanks of the attacking force are

partially secured by the river banks; the reentrant enables the attacker to so locate his supporting weapons as to obtain better flanking fires; and the area that must be neutralized by his supporting fires is smaller. However narrow reentrants are avoided because a small defending force may be able to bottle-up the attacking force in a narrow U-shaped reentrant.

Objectives are selected prior to crossing. (See figure 2.)

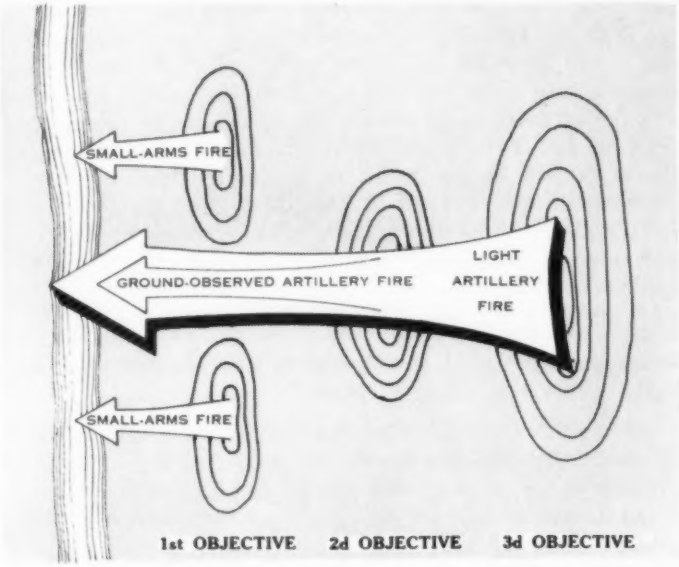


FIGURE 2.—The attacker selects three successive objectives. The first eliminates small-arms fire from the bridge site; the second eliminates ground-observed artillery fire; the third eliminates light artillery fire.

The commander responsible for the crossings selects a series of objectives on the far bank the capture of which will enable him to accomplish his mission. Generally, three successive objectives will satisfy this requirement. The first objective should be deep enough to eliminate all small-arms fire from the bridge site. When it has been seized, the engineers can start construction of foot-bridges and infantry

support rafts. The second objective should be a terrain feature which, when captured, well deny the enemy ground-observed artillery fire on the crossing site. It should also be within supporting range of the attacker's artillery. When the second objective is secured, the engineers can begin work on a support-type bridge. The third objective should be far enough inland to prevent the defender's light artillery from reaching the crossing site. When it is secured, the bridgehead is considered established. The capture of the third objective does not necessarily eliminate all artillery fire from the crossing site since some of the heavier artillery pieces have ranges up to thirty miles; however, the elimination of light artillery fire from the bridge site permits the attacker to accelerate the movement of his troops and supplies. Frequently the requirement of two of these objectives will be continued in a single terrain feature, and sometimes it will not be possible to find three successive terrain features that will meet the requirements. However, these principles must still be considered when selecting objectives on the far shore.

Initial, intermediate and final objectives are assigned to each subordinate unit in occordance with the part it is to play in the overall plan of maneuver.

Instructions for the crossing are issued in the rear assembly area. The rear assembly area should be out of enemy artillery range, should offer cover and concealment, and should be within easy marching distance of the river. The forward assembly area is a coordination point where the assault units link up with the assault boats and engineer crews which are to ferry them across the river. The forward assembly area should be large enough to permit troop dispersion, should afford cover and concealment, and should be located as close as practicable to the river so troops will not to be exhausted by hand carrying the assault boats to the river bank. It should have a good road net leading to it in order to facilitate trucking the assault boats into the area by the engineers, and it should provide access to good routes for carrying the assault boats to the river bank.

Surprise is gained by secrecy and deception. The defender of a river line knows that sooner or later the attacker will attempt to cross the river. Therefore the attacker must deceive the defender as to the time and place of crossing. To do this he maintains secrecy and/or uses deception in his preparations. The attacker achieves deception by the use of feints to mislead the defender as to the location of the main crossing site. In a river crossing a feint is an actual attack across the river and not merely a demonstration. The feint is usually conducted by a unit the size of a regiment or larger and is executed by a self-contained task force which is able to support itself on the far bank if the feint is successful. He places smoke at points along the river where no crossing will be made in an effort to draw the enemy's reserve opposite those points while he is crossing at other sites. By demonstrations, he simulates activity at points other than the main crossing site to divert the defender's attention.

Timing is essential in planning the attack. Usually a river crossing is made during darkness, using the first light to reorganize and push on to the objectives. However, the attacker's reconnaissance may indicate that the defender is especially alert during these hours and that another time for the crossing is advisable. Time schedules for each phase of the attack are planned and executed so that the operation is coordinated. Correct timing of the movements of assault boats and their crews from the forward assembly area to the river's bank is essential. If some boats leave too early, surprise may be lost. If others leave too late, their zones of action on the far river bank will not be cleared promptly. Therefore, forward assembly area departure times are controlled so that all boats reach the near bank at the same time.

Maximum fire support is employed for the crossing. Plans for the crossing should include provisions for delivery of maximum supporting fires before and during the actual crossing while the troops are in boats and are vulnerable to any type of enemy fire. This fire support must be continued after the crossing to neutralize enemy fires, produce

casualties, and further disrupt the defenses. However, when the attacker desires to gain surprise in his crossing, this fire is generally withheld until the crossing is discovered. On the other hand, if the river line is very strongly held and the attacker feels that the effect of preparatory fires is worth the loss in surprise, long and intensive preparations should be fired before the crossing begins.

Speed is emphasized in executing the attack. From the time the first assault boats leave the forward assembly area, speed is essential. Instead of bucking the current, boats are angled to make maximum use of the current to assist in propelling them to the far bank as soon as possible. This method expedites crossing and reduces the time that the

FIGURE 3.—The leading elements cross in waves of M2 assault boats.

troops are exposed to the defender's fire. After gaining an initial foothold on the far bank, the landing units must be rapidly reinforced and enemy resistance must be quickly eliminated so that the attacking troops have room to maneuver. The attacker pushes his reserves across the river as soon as possible so that he can repel the defender's counterattacks and push out of the bridgehead before the defender has time to regroup his forces. The assigned objectives

must be captured as soon as possible because they are usually the key terrain features which control the area. If given time to move his reserves, the enemy may reinforce his defenses and thus delay, or actually break up the attack.

Rehearsals are necessary to obtain speed and precision. Regardless of how thorough the attackers plan for his crossing, rehearsals are needed to test time and space factors, to acquaint the troops with the method of loading and handling the boats, to develop coordination in and between the boat crews, and to thoroughly explain and demonstrate the plan of the attack. These rehearsals should be held on terrain similar to that where the crossing will be made.

ORGANIZATION

When the crossing sites and objectives have been selected, the crossing unit is organized into waves. Each wave consists of a group of assault boats or storm boats and

FIGURE 4.—A nine-man rifle squad and a three-man engineer crew cross in one boat. The engineers paddle the boats back across the river so that they can be used for shuttling other troops if necessary.

crews, all of which cross the river at the same time. Usually a unit spearheads its crossing with three waves of powered storm boats if available or M2 assault boats, and subsequent waves cross by the same means or on footbridges. Definite

elements of the unit making the crossing are assigned to each wave. In crossing a battalion the first three waves are organized as follows: the first wave consists of the rifle platoons of the rifle companies, each reinforced by a 57-mm rifle squad; the second wave consists of the weapons

FIGURE 5.—Machine gun squads from the heavy weapons company cross in the third wave.

platoons (less 57-mm section) and the company headquarters groups of the assault rifle companies with their attached mortar and artillery observers; the third wave consists of the heavy weapons company and the advance echelon of the battalion headquarters, advance elements of the medical platoon, engineers, and liaison personnel. The remainder of the personnel of the assault battalion are organized into waves that cross by footbridge or, if not available, cross by whatever means is available—if necessary in unusual circumstances by floating their equipment across and swimming. It is vital that the reserve be crossed at the scheduled time since its early employment may expedite the accomplishment of the mission, or may turn the tide of a counterattack.

A priority for the crossing of vehicles on the infantry support rafts is established giving preference to ammunition carriers, medical vehicles, reconnaissance vehicles, and communication vehicles. M26 tanks mounting 90-mm guns are the infantry regiment's most effective weapons

against tanks but cannot be floated across unless the rafts are specially constructed and capable of carrying very heavy weight. Usually M26 tanks are given priority on the main vehicle bridge as soon as it is constructed. Assault units rely initially on their 75-mm rifles and rocket launchers (which cross with the first three waves) for antitank protection on the far shore.

FIGURE 6.—Personnel not assigned to assault boats double time across the footbridge.

FIGURE 7.—Artillery usually displaces across vehicle support bridge. However, infantry support rafts will float a 2½-ton prime mover and a 105-mm howitzer.

CONDUCT OF THE ATTACK

The application of the foregoing principles and organization in the execution of a typical plan can best be illustrated by tracing in detail the actions of a unit in its advance from the time it leaves its rear assembly area to the

capture of its first objective. After the prelminary plans are complete, all members of the unit are thoroughly oriented. All commanders issue their detailed instructions and orders in the rear assembly area.

The troops move from the rear assembly area to the forward assembly area at the scheduled time and check enroute through traffic control stations. At the entrance to the forward assembly area, the platoon leaders meet their engineer guides and are told the exact time at which the

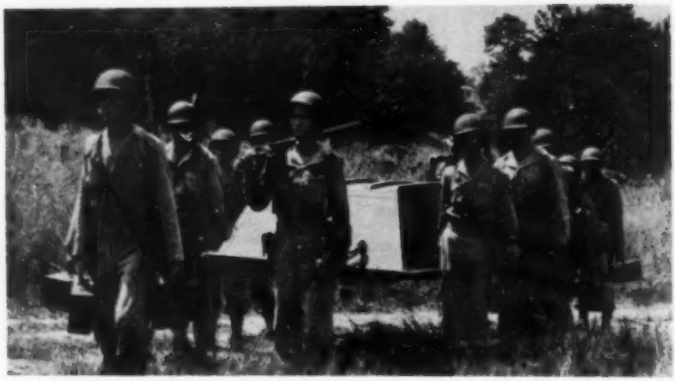


FIGURE 8.—A weapons squad picks up its boat and prepares to move to the river bank.

boat teams must move their boats from the forward assembly area to the river bank. The platoon leaders notify each boat team of the exact time it will move from the forward assembly area. At the specified time the engineer guides lead the boat groups to their assigned boats. The infantrymen pick up their assault boats and move over the previously reconnoitered routes to the river. From the forward assembly area to the far bank, the infantry boat groups are under the control of their engineer guides. (See figure 8 and 9.)

At the river, they turn their boats over and launch them. (See figure 10.) The boat team and the engineer guides load quickly and paddle swiftly and quietly across the river. Bayonets are not fixed until the far bank is reached because

accidents are more frequent and noise is greater when bayonets are fixed beforehand. Weapons are not fired from the boats because the muzzle flash gives the defender a target on which to concentrate his fire and decreases the

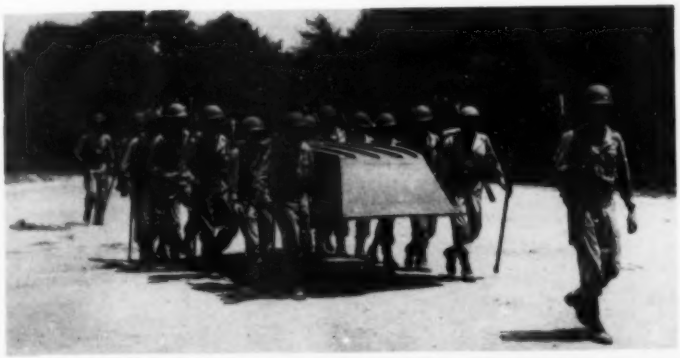


FIGURE 9.—Three men in addition to the rifle squad and the engineer crew can be ferried across in each M2 assault boat.

rate of crossing by breaking the rhythm of paddling. The men paddle directly to the far bank without attempting to buck the current.

As soon as the boats ground on the far bank, the occupants debark and fan out. The first wave rushes straight in for a predetermined distance (75 to 125 yards) shooting, throwing grenades, and using bayonets if necessary, to clear all resistance. Platoons hastily reorganize at a predetermined rallying point before continuing the attack to the objective.

The reserve crosses at the time designated or on order from the unit commander. If the footbridge is in, the reserve uses it; if not, the crossing is made by assault boats, by swimming, by utilizing rafts, or by any other means available. Upon reaching the far bank, the reserve moves to its previously assigned assembly area.

The attack is pushed forward continuously and forcefully to gain room for maneuver and to provide room on the far bank for the supporting weapons. Reserves are often engaged earlier than in other types of operations because

objectives are limited and must be occupied as soon as possible. Reserves are employed to exploit breakthroughs, to expedite the capture of an objective, to protect flanks, or to gain maneuver space.

SUPPORTING MISSIONS

Antitank security measures are planned for both the near and the far banks. On the near bank antitank weapons have the primary mission of protecting the rear and forward assembly areas. On the far bank an alert defender can be

FIGURE 10.—A heavy machine gun squad prepares to launch an assault boat.

expected to launch a counterattack with tanks very early in the operation to cut the attacker off from his supply and communication lines and to prevent the construction of support bridges. The attacker carries his 75-mm rifles and rocket launchers in the assault waves and uses them for antitank protection.

The attacker places his tanks in positions on the near bank from which they can fire antitank missions on the far bank until they are able to move forward across the river. Adequate communication and observation is established by the tank company to insure effective delivery of this fire.

Antiaircraft units have the primary mission of protecting the bridge site and the bridge from hostile aircraft. The

bridge site is the hub of antiaircraft defense because the defender, realizing that when the bridge is completed the attacker will greatly reinforce his assault echelon, usually uses aircraft to prevent the construction of the bridge or to destroy it if it is completed.

FIGURE 11.—Engineers construct the infantry support bridge as soon as possible after ground observer artillery fire is removed from the bridge site.

Artillery is assigned its usual mission in the attack of a river line—to provide close and continuous support to the attacking units. From initial positions on the near side of the river it should be able to support the assault echelon to the second objective. It must then displace across the river so that it can support the attack to the third objective.

Heavy mortar units reinforce the fires of the artillery. They prepare fire data to smoke all known and probable points of enemy observation, and deliver these fires by plan or upon request. They send forward observer parties—as does the artillery—across the river with the assault echelon.

The engineers have numerous missions. They handle the assault boats in which the infantry crosses. They improve the road nets on both sides of the river, prepare the banks of the river for bridges, build the bridges and support rafts, and clear mines from the river bank. They are the technicians of the actual crossing and, of necessity work closely with the infantry troops. (See figure 11.)

The primary mission of communications is to facilitate control—always a difficult problem in a river crossing. Radio is the most dependable means of communication in this type of operation, but sole dependence is placed on no one agency. Visual signals, pyrotechnics, messengers, and wire should be used as alternate means. The W-110 wire will operate for 72 hours under water, and recent tests indicate that wire, WD-1 will operate under water for even longer periods. Wire can be towed across by an assault boat can be laid by aircraft, or can be catapulted across attached to a rifle grenade.

The difficulties of supplying the attacking troops are increased in a river crossing. Each man is usually required to carry at least one day's cold rations, additional ammunition for himself, and extra ammunition for the crew-served weapons. Supply plans provide for the early establishment, usually by the battalion ammunition and pioneer platoon, of a small ammunition dump on the far bank.

Evacuation of the wounded is an important morale factor and receives consideration in the planning of the crossing. During the initial assaults, the wounded are moved by litter to the far bank where improvised collecting stations are set up. They are then loaded in assault boats or amphibious vehicles and transported to the near bank at the earliest opportunity. During this period, additional litter bearers may be detailed from the reserve unit to assist the regular litter bearers. A medical vehicle is brought across on the support rafts as quickly as possible, and is used to transport the wounded from the front to the river bank.

If the assigned mission includes an attack of a river line, close attention to reconnaissance, dispersion, flexibility of plans, preponderance of fire power, and coordination between the arms may well insure that the mission can be accomplished with a minimum of casualties. The responsibility rests with the commander. He must know and understand these principles and insure that all subordinate leaders follow them in accomplishing their respective parts of the assigned mission.